

NEWMAN'S GRAMMAR
OF
ENTOMOLOGY.

9591 B 38

QL 463
N55

London:
Printed by Richard Clay,
Bread-street Hill.

CORNELI
UNIVERSITY
LIBRARY

THE
GRAMMAR
OF
ENTOMOLOGY.

BY
EDWARD NEWMAN

LONDON:
FREDERICK WESTLEY AND A. H. DAVIS,
STATIONERS'-HALL-COURT

1835.

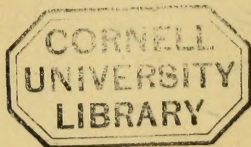


LIBRARY
UNIVERSITY
OF TORONTO
QL463
N55

Ent.

9591 B 38.

A.24830



My wish and judgment about the affair has always been this; that I should much prefer that some one of those, more skilful than myself, had undertaken it; but still that it is better even I should undertake it, than it be left undone.

9591 B 38.

PREFACE.

TEACHERS in science are nearly equally divided into two classes ; those who know too much, and those who know too little. Those of the first class, overloaded with science, cannot admit the possibility of meeting with readers who have none ; and, therefore, their essays and introductions are so worded that it requires a tolerable proficiency to understand them. The teachers of the second class fall into the opposite error ; they curtail, garble, and popularize the writings of others without understanding them, forgetful that it requires a consummate knowledge of any science to abridge a work which treats of it

ably and at large. The Author submits, with much humility, that both classes are in error: he submits also that introductory works should be written *for* those who know nothing of the subject on which they read, and *by* those who possess, in themselves, some practical knowledge of the subject on which they write.

In accordance with these views, the Author has written the following pages; he supposes his reader utterly ignorant of Entomology, and endeavours to show him that it is the History of Insects, and the Physiology of Insects, and the Classification of Insects, and the Art of Preserving Insects: he does not address himself to the professed entomologist; to such this work will be of little value.

The First Book, entitled History of Insects, is a complete compilation; a series of histories

copied, in many instances *verbatim*, from the accounts of those authors who relate what themselves have witnessed. Objections will probably be raised to this plan, but the Author thinks without reason. What good purpose would have been answered, had he so curtailed, transposed, and altered these histories, that their very authors should not have known them? On the contrary, is there not a good purpose answered in collecting together the most interesting observations of Huber, Smeathman, Rusticus, Kirby, Spence, Clark, Fries, Bevan, Delta, and Haliday? No concealment is attempted: the authority for each history is given, except when dependent on the Author's own observation.

The Second Book, entitled Physiology of Insects, is the record of the Author's own observations: he has given the names employed by other writers, when he could under-

stand to what parts they referred, but in names alone has he availed himself of their labours; the facts, the descriptions, are entirely his own. For one chapter, that on the Organs of Circulation, he is indebted to Mr. Bowerbank: by means of that gentleman's splendid microscope he made the observations therein recorded. Mr. Bowerbank's account of the same observations has been given in the *Entomological Magazine*, (vol. i. p. 239): his account and the Author's somewhat differ, but not sufficiently to cause the slightest doubt of the correctness of either, in the mind of a candid reader. The differences are those of opinion only.

The Third Book, entitled *Classification of Insects*, may be charged with being too original: it may be said that the Author should have given the views and arrangements of others in preference to his own. He would ask,

whose system was he to select? That his own is the most simple and the most readily understood, no one will deny: that it is more perfect, or more accurate, or more philosophical, than any other, he does not presume to contend. As for a disquisition on system, it would have been dangerous ground; pleasurable to the writer, but unprofitable to the reader: it would have doubled the size of the volume without adding a fraction to its value.

The Fourth Book, entitled the Preservation of Insects, contains nothing worthy of comment; it will be useful to those who wish to make it so, and that has been the Author's only object in writing it.

The want of an easy introductory work on Insects has been obvious to many. or the last two years, during which time it has been

generally known that he has contemplated the task, the Author has received numerous and pressing solicitations to proceed with it: he has at last made the attempt. He has done his best; whether successfully or not, others must decide.

TABLE OF CONTENTS.

BOOK I.—HISTORY OF INSECTS.

Chap.		Page
I.	History of Insects in general	3
II.	————— The Silkworm	7
III.	————— Apple Moth	13
IV.	————— Musquito	18
V.	————— Bot	23
VI.	————— Bee	27
VII.	————— Ichneumon	40
VIII.	————— Burying Beetle	46
IX.	————— Apple Weevil	51
X.	————— Earwig	54
XI.	————— Locust	58
XII.	————— Coccus of the Vine	62
XIII.	————— Hop-fly	66
XIV.	————— Ant Lion	72
XV.	————— White Ant	77
XVI.	Concluding Observations	86

BOOK II.—PHYSIOLOGY OF INSECTS.

I.	Physiology of Insects in general	93
II.	Of the Organs of Support in general	97
III.	————— in the head	106
IV.	Of the Wings and Legs of Insects	121
V.	Of the Characters of Surface	129
VI.	Of Muscles, the Organs of Motion	133
VII.	Of Nerves, the Organs of Sensation	137

Chap.	Page
VIII. Of the Alimentary Canal, or Organs of Digestion	143
IX. Of the Organs of Circulation	147
X. Of the Organs of Respiration	152
XI. Concluding Observations	156

BOOK III.—CLASSIFICATION OF INSECTS.

I. Classification of Insects in general	163
II. ————— Lepidoptera	173
III. ————— Diptera	181
IV. ————— Hymenoptera	198
V. ————— Coleoptera	218
VI. ————— Orthoptera	239
VII. ————— Hemiptera	242
VIII. ————— Neuroptera	246
IX. ————— Of Ticklers, Bee-Parasites, Fleas, Thysanura, Anop- lura; and concluding Obser- vations	250

BOOK IV.—PRESERVATION OF INSECTS.

I. Apology for the Collector of Insects	259
II. Of the Dress and Instruments for the collection of Insects	262
III. Of capturing Insects	268
IV. Of killing and setting Insects	274
V. Of Entomological Cabinets	282
VI. Of Entomological Books	287
VII. Of investigating Insects	294
VIII. Of Entomological Societies	298

EXPLANATION OF PLATES.

PLATE

I. To face the Title of Book I. represents the Ant-lion at the bottom of his pit. (See Book I. Chapter XIV.)

II. To face the Title of Book II.

Fig. 1. Copper Butterfly (*Lycæna dispar*), caterpillar (*larva*), 4.

2. Copper Butterfly, chrysalis (*pupa*), 4.

3. Copper Butterfly, perfect insect (*imago*), 4.

4. Head of Copper Butterfly.

œ Eye (*Oculus*), 385.

o 4 Blade of feeler jaw (*lacinia*), 411, 412.

u Lower lip (*labium*), 394.

4 Labial feelers (*labipalpi*), 398.

5. Horse Bot (*Estrus Equi*), grub (*larva*), 69.

6. Ditto (Ditto), chrysalis (*pupa*), 72.

7. Ditto (Ditto), perfect insect, (*imago*), 73.

8. Mouth of the Gad-fly (*Tabanus bovinus*).

a Upper lip (*labrum*), 391.

e Tongue (*lingua*), 406.

i i Mandibles (*mandibulæ*), 423. 425.

o 4 Blade of feeler jaw (*lacinia*), 411. 413.

δ δ Maxillary feeler (*maxipalpus*), 422.

u 4 Tip of lower lip (*ligula*), 399. 401.

9. Ichneumon of the Tiger-moth (*Pimpla Instigator*), maggot (*larva*), 131.

10. Ichneumon of the Tiger-moth, chrysalis (*pupa*), 131.

11. Ichneumon of the Tiger-moth, perfect insect (*imago*), 124.

12. Mouth of the Ichneumon.

a Upper lip (*labrum*), 391.

i Mandible (*mandibula*), 423, 428.

o 2 Disk of feeler jaw (*maxilla*), 409.

o 3 Feler bearer (*palpifer*), 410.

PLATE

II. Fig. 12. o 4 Blade (*lacinia*), 411.ö Helmet (*galea*), 418. 420.δ Maxillary feeler (*maxipalpus*), 422.u 2 Lower lip proper (*labium*), 394.u 4 Tip of lower lip (*ligula*), 399. 401.d Labial feeler (*labipalpus*), 398.

III. To face the Title of Book III.

Fig. 1. (*Orchesia micans*), grub (*larva*).2. (Ditto), chrysalis (*pupa*).3. (Ditto), perfect insect (*imago*).4. Common Cricket (*Acheta domestica*), (*larva*).5. Lower lip of Common Cricket (*labium*), 394.u 1 Insertion (*Insertio*), 395.u 2 Lip proper (*labium proprium*), 396.u 3 Feeler bearer (*palpiger*), 397.u 4 Tip of the lower lip (*ligula*), 399. 405.d Labial feeler (*labipalpus*), 398.6. Painted Plant-bug (*Acanthosoma picta*), perfect insect (*imago*).7. Pearl-fly (*Perla bicaudata*), (*larva*).

8. Feeler jaw of the Pearl-fly.

o 2 Disk (*maxilla*), 409.o 4 Blade (*lacinia*), 411.ö Helmet (*galea*), 418.δ Maxillary feeler (*maxipalpus*), 422.9. Fore wing (*proala*) of the Pearl-fly, 441.10. Hind leg (*metapes*) of Ditto, 451.b The hip (*coxa*), divided by a line, 454.d The thigh (*femur*), its first and second joint being minute, and adjoining the coxa, 455.f The shank (*tibia*), 456.g The foot (*tarsus*), 460.h The claws (*unguiculi*), 462.k The little cushion (*pulvinulus*), 465.

IV. To face the Title of Book IV.

Fig. 1. Water net, 849.

2. Clap net, 851.

3. Forceps, 848.

4. Bent pin, 899.

5. Minute insect mounted, 893.

6. Beetle pinned, 887.

7. Vial for minute Hymenoptera, 854.

8. Larva cage, 874.



Ant. Linn. et. Le. Lottom. et. Linn. Pl.

THE
GRAMMAR
OF
ENTOMOLOGY.

BOOK I.
HISTORY OF INSECTS.

Go to the ant, thou sluggard; consider her ways, and
be wise.

BOOK I.

HISTORY OF INSECTS.

CHAPTER I.

HISTORY OF INSECTS IN GENERAL.

1. THE history of an insect, like the history of a man, is an account of life from first to last, from birth to death. Insects are so constituted, that the history of an individual is the history of its race : climate, season, or circumstance, exercises little power of creating differences among them ; a bee is as essentially a bee, and a butterfly a butterfly, at the equator as at the poles ; and in either situations performs the same acts.

2. Insects of all kinds and in all situations resemble each other in these points :—they proceed from the parent as eggs, the eggs are hatched and become grubs, in which state they eat, increase rapidly in size, and are invariably without wings ;

the grubs, when full grown, become for a time motionless; their skin opens, and from it comes forth the perfect insect, which has four wings, and which does not increase in size.

3. In a very great number of insects, the grub changes its skin, and completely alters its form on becoming motionless; indeed, almost as great a change in appearance takes place, as in the change from the grub to the perfect state; when this is the case, the motionless state is called the *chrysalis*.

4. Thus we have four stages in the life of an insect, four states which it is necessary thoroughly to understand; the egg (*ovum*) which is motionless, and apparently lifeless; the grub (*larva*), which is active, but without wings, voracious, and grows rapidly; the chrysalis (*pupa*), which is quite motionless, and which does not occur in all insects; the perfect insect (*imago*), which is active, has wings, does not grow, and which, by laying eggs, perpetuates its kind.

5. The names *egg*, *larva*, *pupa* and *imago*, are the terms generally employed in descriptions; the three last answer equally well for Latin or English, but it must be borne in mind that the words *grub*, *maggot*, and *caterpillar*, are synonymous with the term *larva*; and *perfect insect*, *fly*, &c. are synonymous with the term *imago*; and the English and Latin words are used in English descriptions almost indifferently.

6. These transformations are in reality nothing more than a continual casting of the outer skin ; the larva often casts its skin four or five times without any very remarkable change of form ; every casting of the skin is a step towards arriving at ultimate perfection. In every insect the skin must be cast a certain number of times, and the last casting brings it to maturity.

7. On account of their small size, it is difficult to find common examples of the *eggs* of insects ; those laid on meat by the blue-bottle fly must be known to many ; the silk-worm's eggs again are not unknown ; but the generality of insects' eggs are so concealed and so little conspicuous, that they are found with difficulty.

8. Examples of *larvæ* are numerous ; the maggots found in wasps' nests, and used in fishing ; the maggots in apples and in nuts ; the maggots in cheese, and in decaying substances ; and the caterpillars, which devour our cabbages, which spin webs on our apple, pear, and plum trees, in the spring, are familiar to us all : these are insects in the larva state.

9. The *pupa* state is more difficult to find, because insects generally crawl away into crevices or underground, and hide themselves before changing to this state ; an angular pupa of a green colour, with small black spots, which produces a common white butterfly, may, however, be continually seen on palings and walls of gardens, and

the smooth brown pupæ of moths are continually dug up in gardens.

10. The *imago*, or perfect state, is exemplified in butterflies, moths, gnats, flies, wasps, bees, ants, beetles, grasshoppers, earwigs, cockroaches, bugs, fleas, may-flies, and dragon-flies. All descriptions of insects in scientific works, relate to the imago state, unless the contrary is distinctly expressed.

11. All perfect insects have two feelers (*antennæ*) rising from their heads, like horns; four wings, the first pair called *fore wings* (*proalæ*), the second pair *hind wings* (*metalæ*); six legs in pairs, the first pair called *fore legs* (*propedes*), the second pair, *middle legs* (*mesopedes*), and the third pair, *hind legs* (*metapedes*).

12. These parts are believed always to exist, yet are sometimes very indistinct; when they are conspicuous, they are said to be *developed* (*patefacti*), when small, and scarcely performing their usual functions, *rudimental* (*incipientes*), when undiscovered, and therefore not possibly applicable to their usual functions, *obsolete* (*obsoleti*).

13. The mode in which the life of an insect is passed, differs very widely in the states of its existence: it often happens that the larva inhabits the water, and the imago the air; sometimes the larva inhabits the water, the pupa inhabits the earth, and the imago returns to the water. The following chapters will in some degree exemplify this.

CHAPTER II.

HISTORY OF THE SILKWORM.

Class.....	Lepidoptera.		Genus Bombyx.
Order	Bombycites.		Species..... Mori.

14. SILK has been a valuable article of commerce, and a favourite one for dress from time immemorial; the archives of China are said to speak of its existence five thousand years ago, but the period at which it was first appropriated to the uses of man cannot be traced.

15. The manufacture of silk, in this country alone, is supposed to find constant employment and means of support for about five hundred thousand human beings; in France, Germany, Italy, Turkey, and the continent of Asia, it is also an article of great commercial importance.

16. Silk is a native production of China and India; it was introduced into Europe A.D. 550, by two monks, who brought the eggs of the silk-worm, in hollow canes, to Constantinople,

and there succeeded in rearing the worms and obtaining their produce.

17. Silk is now produced abundantly in Europe, principally in Murcia, in Spain, the south of France, and in Italy; in Hungary it is cultivated, but with less success; and in England, probably from the want of sufficient warmth, all attempts hitherto made have proved unsuccessful.

18. Silk is spun by a caterpillar, which feeds on the leaves of the mulberry-tree; it is called the silk-worm; it comes from eggs laid by a moth in the autumn of the preceding year.

19. In May the eggs are hatched, and produce small black caterpillars, less than the tenth of an inch in length; these increase daily in size, and gradually alter their colour till they become nearly white.

20. In this country, the caterpillar takes fifty-six days to arrive at perfection, during which time it invariably sheds its skin as many as four, and occasionally five times; the cause of this occasional additional change is not known. After every change the caterpillar is lighter in colour, and has a larger head than previous to the change; it spins during five or six days, making about sixty-two days.

21. In warmer climates the caterpillar arrives at its full growth in forty-seven days, and has finished spinning in five more, making together fifty-two days; these may be counted thus :—

hatching to first change, seven days; changing, two days; before the second change, seven days; changing, two days; before the third change, seven days; changing, three days; before the fourth change, seven days; changing, four days; before beginning to spin, eight days; spinning, five days.

22. When the caterpillar is about to change its skin, it ceases to eat, holds its head up stiff, and appears ill and sulky; the new head is plainly to be discovered through the transparent skin, behind the old one, and rather of a triangular shape—the apex of the triangle being uppermost; after remaining in this state two or three days, as above stated, the skin opens behind the head, which cracks longitudinally, and is cast with the skin; the caterpillar then twists itself from side to side, and writhes about, while the skin gradually slips from its body, and comes off at the tail.

23. Whilst the silk-worms are feeding, they should be kept very clean, and abundantly supplied with fresh leaves; open trays, made of pasteboard, are very convenient for holding them; and from these, if supplied with food, they never wander.

24. Care should be taken to preserve silk-worms from birds and mice, both of which are excessively fond of them; the influence of the sun is highly injurious to them, as are also cold

north and east winds ; but plenty of air in warm weather is beneficial. The leaves should be given to them perfectly dry ; if brought from a distance, they preserve their freshness for many days in a tin box, or on the cold bricks or stones of a cellar.

25. After the fourth change, the silk-worms require constant watching ; twice a day they should be carefully looked over, and those ready to spin picked out, and placed in little cells, made of writing-paper, about as large as one's thumb, open at one end, and closely screwed up at the other ; their paper cells may be pinned to lines crossing a room, and placed touching each other on the line.

26. The period of a silk-worm being ready to spin is plainly indicated by its ceasing to eat, and becoming suddenly more transparent and of a yellow colour ; it will also begin to spin a few threads of silk among the leaves, or in a corner of the tray.

27. The silk-worm, when placed in the cell, spins a few loose connecting threads, attached to every side of the cell : it then forms a regular oval ball of silk, which is suspended in the centre of the cell, and in the interior of which it continues to work for five days.

28. If the cells containing the spinning silk-worms, are placed regularly on the line in the order in which they begin spinning, then there will occur no difficulty in taking them off, in the succession in which they stand, as the first in

order on the line will be the first requiring to be wound off.

29. After a silk-worm has been ten days in its cell, its cocoon of yellow silk will be compact and complete; this must be taken out of the cell, the exterior or waste silk stripped off, until a single thread runs by itself; an operation which will be much assisted by occasionally dipping the cocoon in warm water.

30. When the single threads of half a dozen of these cocoons are found, they may be guided with one hand on a small reel, which is constructed for the purpose, and may be turned with the other hand, the cocoons at the same time floating on a basin of warm water; by a little management in separating the thread, a great number may thus be wound off at the same time.

31. When so much of the silk has been wound off, that the remainder appears of a thinner, paler, and inferior quality, the thread should be broken, the remaining portion of the cocoon is weak, gummy, and of little value; it should be taken out of the water, and laid aside to prevent its getting entangled with the others.

32. Within the cocoon is the chrysalis, from which the future moth is produced; these may be thrown on a tray containing bran, which absorbs the water which would otherwise remain on them after their long soaking. When silk-worms are reared for profit, there are a far greater number

of chrysalides than are wanted; these may be given to fowls, which are exceedingly fond of them, and to which they afford a wholesome and nutritious diet.

33. In a fortnight or three weeks after the winding of the silk, some of the chrysalides will be found cracking and opening, and the perfect moth will then appear: these are small sluggish creatures, of a pale buff colour, seldom leaving the tray, mat, or paper, on which they are placed, and on which the females lay their eggs.

34. As regards the hatching of the eggs, it is important to know that this may be retarded as long as the owner pleases, by subjection to a low temperature; and it will be well for those who purpose keeping silk-worms for the sake of profit to defer the hatching of the eggs until the mulberry-trees are sufficiently forward to ensure a constant supply of food.

35. The usual time for the hatching of silk-worms' eggs in this country is about the 12th of May, but a fortnight later is much better; for at that time the mulberry-trees have not generally put forth their leaves, and a great difficulty constantly occurs in procuring food.

36. No other food than mulberry leaves, as far as we have yet learned, affords to silk-worms wholesome nutriment; lettuce, dog-wood, and black-currant leaves, have been repeatedly tried, but without success.

CHAPTER III.

HISTORY OF THE APPLE MOTH.*

Class.....	Lepidoptera.		Genus	Cydia.
Order	Tortricites.		Species.....	Pomonana.

37. THE apple-moth is a beautiful little creature; its wings are studded with silvery shining specks, as though they were inlaid with precious gems: it is the most beautiful of the beautiful tribe to which it belongs, yet, from its habits not being known, it is seldom seen in the moth state, and the apple-grower knows no more than the man in the moon to what cause he is indebted for his basketsful of worm-eaten windfalls in the stillest weather.

38. To find the moth in the day-time, the trunks of the apple-trees should be carefully looked over; or if your orchard be surrounded by a wooden fence, it may frequently be found sitting against it, with its pretty wings neatly folded round it.

* RUSTICUS, in the Entomological Magazine.

39. Towards evening, in fact, just at sunset, it begins to move, and may then be seen hovering about the little apples, which, by the time the moth leaves the chrysalis, the middle of June, are well knit, and consequently fit for the reception of its eggs, which it lays in the eyes, one only in each, by introducing its long ovipositor between the leaves of the calyx, which form a tent above it that effectually shields it from the inclemency of the weather, or any other casualty.

40. As soon as the egg hatches, the little grub gnaws a hole in the crown of the apple, and soon buries itself in its substance; and it is worthy of remark that the rind of the apple, as if to afford every facility to the destroyer, is thinner here than in any other part, and consequently more easily pierced: the apple most commonly attacked is the codling, a large early sort, which ripens in July and August.

41. The grub, controlled by an unvarying instinct, eats into the apple obliquely downwards, and by thus avoiding the core and pips in no way hinders its growth: at first it makes but slow progress, being little bigger than a thread, but after a fortnight its size and its operations have much increased; it has now eaten half way down the apple, and the position of the hole at the top, if the apple continue upright, or nearly so, is inconvenient for a purpose it has up to this time been used for, that is, as a pass to get rid of its

little pellets of excrement, which are something like fine sawdust or coarse sand.

42. Another communication with the outer air is for this purpose required, and it must be so constructed as to allow the power of gravity to assist in keeping it clear; it is accordingly made directly downwards towards that part of the apple which is lowest, and thus the trouble of thrusting the pellets upwards through the eye of the apple is saved, and a constant admission given to a supply of air without any labour.

43. The hole now made is not, however, sufficiently open for an observer to gain by its means any knowledge of what is going on within; this is only to be obtained by cutting open a number of the apples as they gradually advance towards ripeness; the hole is, however, very easily seen, from its always having adhering to it on the outside an accumulation of the little grains which have been thrust through.

44. Having completed this work, the grub returns towards the centre of the apple, where he feeds at his ease. When within a few days of being full fed, he for the first time enters the core through a round hole gnawed in the hard, horny substance which always separates the pips from the pulp of the fruit, and the destroyer now finds himself in that spacious chamber which codlings in particular always have in their centre.

45. From this time he eats only the pips,

never again tasting the more common pulp which hitherto had satisfied his unsophisticated palate: now nothing less than the highly-flavoured, aromatic kernels will suit his tooth, and on these for a few days he feasts in luxury.

46. Somehow or other, the pips of an apple are connected with its growth, as the heart of an animal with its life;—injure the heart, an animal dies: injure the pips, an apple falls: whether the fall of his house gives the tenant warning to quit, is not known, but quit he does, and that almost immediately; he leaves the core, crawls along his breathing and clearing-out gallery, the mouth of which, before nearly closed, he now gnaws into a smooth, round hole, which will permit him free passage without hurting his fat, soft, round body; then out he comes, and for the first time in his life finds himself in the open air.

47. He now wanders about on the ground till he finds the stem of a tree: up this he climbs, and hides himself in some nice little crack in the bark: we should remark, that the fall of the apple, the exit of the grub, and his wandering to this place of security, usually take place in the night-time. In this situation he remains without stirring for a day or two, as if to rest himself after the uncommon fatigue of a two yards' march; he then gnaws away the bark a little in order to get further in out of the way of observation; and

having made a smooth chamber big enough for his wants, he spins a beautiful little milk-white silken case, in which, after a few weeks, he becomes a chrysalis.

48. In this state he remains throughout the winter and until the following June, unless some unlucky, blackheaded tit, running up the trunk, peeping into every cranny, and whistling out his merry see-saw, happen to spy him, in which case he is plucked without ceremony from his retreat, and his last moments are spent in the bird's crop ; but supposing no such ill-fortune betide him, by the middle of June he is again on the wing, and hovering round the young apples on a midsummer evening as before.

49. By burning weeds in your gardens at this time of year you will effectually drive away this little moth. If you have trees, the crops of which you value, make a smoking (mind, not a blazing) fire under each ; it will put you to some inconvenience if your garden be near your house, but the apples will repay you for that.

CHAPTER IV.

HISTORY OF THE MOSQUITO.*

Class.....	Diptera.	Order.....	Simuliites.
	Genus.....		Simulia.

50. THE eggs of the mosquito (*Simulia*), and the mode in which they are laid, appear to be at present unknown; there is, however, little doubt but that, like those of other gnats, they are deposited on the surface of the water, and in that situation are hatched by the warmth of the sun combined with the moisture of the water.

51. The larva is found on the stems of water-plants (*Phellandrium*, &c.); on those portions which are always covered by the water: it is long, cylindrical, considerably thickened posteriorly, and nearly transparent: its head is distinctly separated from the body, and is of an oblong form; it has four jaws moving horizontally, each bifid at the tip, and two little horns in the usual place of

* M. Fries in Entomologisches Archives.

antennæ, inserted in the front of the head, rather towards each side: each of these is composed of two joints, the first, or basal joint, stout, the second, or apical one, divided into many rays, which fold back on the first joint: it has two very small eyes on each side of the head.

52. The body of the larva is divided into twelve segments besides the head; of these, the second is incrassated, and furnished below with a retractile conical foot; the last segment is very minute, and furnished with two small prehensile feet: the air tubes, so very plainly seen in other aquatic larvæ, are totally wanting; neither is there the least appearance of spiracles or breathing holes in the sides.

53. The motion of the larva in the water is tolerably brisk; but on any object coming in contact with it, it instantly becomes motionless, attaches itself by the anterior prehensile foot, and remains a long time perfectly still and immovable. When it moves from one place to another, its progression is undulating, somewhat like that of a leech, being performed in this manner:—the anterior foot is firmly attached to some object, then the posterior pair of feet are brought up to it, the back arching up during the operation; the anterior foot then releases its hold; the body is again elongated, the foot attached further on, and the posterior feet again brought up to it.

54. The food of the larva is unknown: when

full grown, it spins a little silken sheath, in shape like a watchpocket, which is attached to the plant which the larva frequents, and in which the larva changes to a pupa in an upright position: the case being always open at top, the head and shoulders of the pupa are seen projecting above it.

55. The pupa much resembles that of a moth: it is perfectly motionless, of a brown colour, and exhibits very distinctly the parts of the perfect insect through its skin: from the back of its head arise on each side four hair-like appendages; these are tubular, and appear to be designed for breathing.

56. About the sixth of July the little creature bursts from its sheath; the case of the chrysalis opens in a right line down the back, and the perfect insect emerges through the opening, surrounded by a bubble of air, and slowly begins to unfold its wings under the water; finally, its skin being cast, and its maturity attained, it disengages itself from its former habitation, and mounts within its bubble to the surface of the water, when the bubble bursts, and the creature has acquired new organs and a new element.

57. The imago is a small black fly, with two large transparent wings, which, when at rest, repose horizontally on its back; moderately long legs, and short stout antennæ; it flies with ease, and somewhat sportively, rising and falling. In this country it is found in the damp parts of

woods, and other similar situations ; but, happily, in very limited numbers.

58. There is scarcely any animal more annoying to men and animals than this little fly: its attacks are made in innumerable multitudes, and it is troublesome not only from the pain and inflammation caused by its bite, but also from the intolerable itching occasioned by its crawling over the skin.

59. In the woody and marshy parts of Lapland, the mosquitoes swarm in the months of July and August; nay, even the summits of the highest mountains, though capped with perpetual snow, impose no obstacle to their progress. Among the numerous gnats and flies which feed on blood, these are the most to be feared; impelled by an insatiate thirst, they make their attack, and will have blood: nothing can repel or deter them.

60. Whenever the garment of a traveller has by accident slipped aside, and discovered a portion of his skin, however small, that exposed portion is instantly streaming with blood: in the southern parts of Lapland they are less troublesome than in the northern, although clouds of them occasionally appear performing their evolutions in the air.

61. The mosquito seems to have adopted the world for its country; no known land appears to be without it; all temperatures suit it—the polar snows, and the blaze of tropical sands. Yet all the flies of which travellers complain as so dreadfully

annoying, are not mosquitoes ; many of our commonest gnats have a similar taste for blood.

62. Although, from what is related, there can be no doubt that the blood of man is an acceptable food to the mosquito, yet it is remarkable that the greatest multitudes of these creatures inhabit those bleak, inhospitable, and almost inaccessible regions where the foot of man seldom treads, and where other warm-blooded animals are scarcely known to exist.

63. It is clearly ascertained that the female mosquitoes alone suck the blood of man ; the males spend their lives among the leaves of trees, or settle on flowers, from which they appear to derive nutriment ; it is therefore far from impossible that, in the failure of animal, the females also may have recourse to vegetable nutriment.

CHAPTER V.

HISTORY OF THE BOT.*

Class.....	Diptera.		Genus	Æstrus.
Order	Æstrites.		Species.....	Equi.

64. THE opinions respecting this singular insect, as to the benefit or injury which horses derive from it, are very various; but observation leads us to suppose that, like many other insect parasites in various parts of the bodies of animals, its existence is scarcely perceptible to the animal which supports it.

65. The female bot flies round the horse, carrying her body nearly upright in the air, and projecting a long tube (*ovipositor*) from the extremity of her body, this tube being bent inwards and upwards: in this way she approaches the part where she designs to deposit the egg; and suspending herself for a few seconds, darts forward, and leaves the egg adhering to the hair.

* Bracy Clark's History of the Bots of Horses.

66. The egg appears to be held out at the extremity of the ovipositor, so that the insect has no occasion to settle, but simply touches the hair, and the egg at once firmly adheres by means of a glutinous matter with which it is covered; she then withdraws to a short distance, prepares another egg, again poises herself before the chosen part, and deposits it in the same way as before: the operation is sometimes repeated until four or five hundred eggs are laid on one horse.

67. The female bot does not lay her eggs at random on any part of the body, but constantly on those parts which are most liable to be licked by the tongue; and never on the head, or parts which cannot be reached by the tongue; the inside of the knee, and the side and back part of the shoulder, are the parts usually selected.

68. When the eggs have remained on the hairs four or five days, the slightest application of warmth and moisture is sufficient to hatch them; at this time, if the tongue of the horse touches the egg, it immediately opens, and a small active worm is produced, which adheres readily to the moist surface of the tongue, and is thence conveyed with the food into the stomach.

69. The maggots are at first long in proportion to their thickness, but as their age advances, they become proportionally thicker and broader; they adhere to the white insensible tissue, or coat of the stomach, usually hanging in dense clusters,

and maintaining their hold by means of their hooked jaws.

70. The maggots make small round holes in the white tissue, sometimes so deep as to go completely through it, but not through the other coats of the stomach; the colour of the maggot is a whitish red, and the segments of its body are surrounded with a double row of horny bristles, a longer and a shorter series; the last two segments are destitute of these bristles: the bristles are of a reddish colour, with black points, which are directed towards the posterior extremity of the maggot.

71. The food of the maggot appears to consist entirely of the coat of the horse's stomach, or of some fluid secreted from it, and not in any degree of the vegetable matter taken into the horse's stomach as food: the maggots pass the autumn, winter, and spring in the stomach of the horse, thus taking nearly a year to arrive at their growth.

72. When full grown, these maggots quit their hold of the coat of the stomach, are carried through the intestines with the food, and fall to the ground, where their skin hardens, and they become pupæ, in which state they turn to a darker colour, but preserve, in a great degree, the shape and character which they possessed as larvæ.

73. In about twenty days after falling to the ground, the shell of the pupa opens at the smaller

end, a portion of the shell falling completely off; and the perfect insect then emerging through the aperture, escapes from his confinement, and soon attains hardness and maturity, and flies away.

74. A second species of bot lays its egg on the lips of the horse, occasioning an annoying itching, at which the animal is much distressed, rubbing his nose violently against the ground, the stem of a tree, or his own legs, or galloping away with all his might: both the larva and perfect insect of this species are smaller than those of the foregoing.

CHAPTER VI.

HISTORY OF THE BEE.*

Class.....	Hymenoptera.	Genus	Apis.
Order	Apites.	Species.....	Mellifica.

75. To the bee we are indebted for two valuable articles of commerce,—honey and wax : since the introduction of sugar, honey has become less an article of general use, and more one of luxury : but wax is still extensively consumed throughout the civilized world.

76. Honey is collected from flowers, is swallowed by the bees, and afterwards regurgitated : the bee, laden with honey, returns to the hive, enters a cell, pierces a hole in the crust on the surface of the honey already therein, disgorges the honey in large drops from its mouth, new models the crust, and closes up the hole ; this mode of proceeding is regularly adopted by every bee that contributes to the general store.

* Dr. Bevan's Honey Bee ; original authority, Huber's History of the Hive Bee.

77. Wax is secreted, as occasion may require, from small sacks, situated between the segments of the body of the bee, on the under side ; it is used for constructing the combs in which the family provision of honey and the young brood are deposited ; the wax of commerce is produced by melting down these combs.

78. A bee-hive contains three kinds of individuals,—a queen, drones, and workers ; the queen is a female, and not only the ruler, but, in great part, the mother of the community ; the drones are males, and the workers are abortive females.

79. The sole office of the queen appears to be the laying of eggs, and this occupies her almost incessantly, as a single one only is deposited in each cell, thus causing her to be in continual motion : she is slow and majestic in her movements, and differs from the workers in being larger, having a longer body, shorter wings, and a curved sting.

80. The queen is accompanied by a guard of twelve workers, an office which is taken in turn, but never intermitted : in whatever direction she wishes to travel, these guards clear the way before her, always with the utmost courtesy turning their faces towards her, and when she rests from her labours, approaching her with humility, licking her face, mouth, and eyes, and fondling her with their antennæ.

81. The drones are all males ; they are less than the queen, but larger than the workers ; they live on the honey of flowers, but bring none home, and are wholly useless, except as being the fathers of the future progeny ; when this office is accomplished, they are destroyed by the workers.

82. A buzzing commences in the hive ; the drones and the workers sally forth together, grapple each other in the air, hug and scuffle for a minute, during which operation the stings of the workers are plunged into the side of the drones, who, overpowered by the poison, almost instantly die.

83. The workers are the smallest bees in the hive, and by far the most numerous ; they have a longer lip for sucking honey than either of the others ; their thighs are furnished with a brush for the reception of the honey of flowers, and their sting is straight.

84. The workers do the entire work of the community ; they build the cells, guard the hive and the queen, collect and store the honey, elaborate the wax, feed the young, kill the drones, &c. The average number of these three kinds of bees in a hive is one queen, 2,000 drones, and 20,000 workers.

85. The eggs are long, slightly curved, and of a bluish colour ; when laid, they are covered with a glutinous matter, which instantly dries, attaching them to the bottom of the cell.

86. For eleven months the queen lays only workers' eggs; after that, those which produce drones: as soon as this change has taken place, the workers begin to construct royal cells, in which, without discontinuing laying the drones' eggs, the queen deposits here and there, about once in three days, an egg which is destined to produce a queen.

87. The workers' eggs hatch in a few days, and become little white maggots, which immediately open their mouth to be fed; these the workers attend to with unerring assiduity: in six days each maggot fills up its cell; it is then roofed in by the workers, spins a silk cocoon, and becomes a chrysalis; and on the twenty-first day it comes forth a perfect bee. The drones emerge on the twenty-fifth day, and the queens on the sixteenth.

88. It has been already stated, that the queen, for nearly a year, lays no eggs that are destined to produce queens; it therefore follows, that if any evil befall her, the hive is left without a queen: it sometimes happens that she dies, or is taken away by the owner of the hive, to observe the result.

89. For twelve hours little notice is taken of the loss; it appears not to be known, and the workers labour as usual: after that period, a hubbub commences; work is abandoned; the whole hive is in an uproar; every bee traverses

the hive at random, and with the most evident want of purpose.

90. This state of anarchy sometimes continues for two days; then the bees gather in clusters of a dozen or so, as though engaged in consultation; shortly after, a resolution appears to have been made; a few of the workers go to work at the cells in which are deposited the eggs of workers; three of these cells are quickly broken into one, the edges polished, and the sides smoothed and rounded, a single egg being allowed to remain at the bottom.

91. When this egg hatches, the maggot is fed with a peculiarly nutritive food, called royal bee-bread, which is never given to any maggots but such as are to produce queens; work is now resumed over the whole hive, and goes on as briskly as before: on the sixteenth day the workers' egg produces a queen, whose appearance is hailed with every demonstration of delight, and who at once assumes sovereignty over the hive.

92. When, under ordinary circumstances, a young queen emerges from the chrysalis, the old one frequently leaves the hive, heading the first swarm for the season, and flying to some neighbouring resting-place, is observed by the owner, captured, placed under a new hive, and a new colony is immediately commenced.

93. Before a swarm leaves the hive, sure

indications are given of the intended movement ; the workers leave their various occupations, and collect in groups, especially near the door of the hive, as though in consultation on the important event about to take place.

94. As the summer advances, many queens are hatched ; but the workers do not allow them instant liberty, as severe battles would take place between them and the reigning queen, in which one would be killed : the workers, therefore, make a small hole in the ceiling of the royal cell, through which the captive queen thrusts her tongue, and receives food from the workers. In this state of confinement the young queen utters a low querulous note, which has been compared to singing.

95. When the reigning, or a newly created queen, finds one of these captives, she uses every effort to tear open the cell, and destroy her rival : to prevent this, the workers often interpose, pulling her away by the legs and wings ; to this she submits for a short time, when, uttering a peculiar cry, called her voice of sovereignty, she commands instant attention and obedience, and is at once freed from her assailants.

96. The cocoon spun by the maggots of the workers and drones completely envelopes the chrysalis ; but that spun by the maggot of the queen appears imperfect, covering only the upper end of the chrysalis : it has been supposed

that they are thus designedly exposed to the attacks of other queens, and their destruction, before emerging, facilitated.

97. When the chrysalis of the queen is about to change to a perfect insect, the bees make the cover of the cell thinner by gnawing away part of the wax; and with so much nicety do they perform this operation, that the cover at last becomes pellucid, owing to its extreme thinness.

98. The combs of a bee-hive comprise a congeries of hexagonal cells, built by the bees as a receptacle for honey, and for the nurseries of their young: each comb in a hive is composed of two ranges of cells, backed against each other: the base or partition between this double row of cells is so disposed as to form a pyramidical cavity at the bottom of each.

99. There is a continued series of these double combs in every well-filled hive; the spaces between them being just sufficient to allow two bees, one on the surface of each comb, to pass without touching.

100. Each cell is hexagonal, the six sides being perfectly equal. This figure ensures the greatest possible economy of material and space; the outer edges of the cells are slightly thickened, in order to gain strength; the same part is also covered with a beautiful varnish, which is supposed to give additional strength.

101. The construction of several combs is

generally going on at the same time : no sooner is the foundation of one laid, with a few rows of cells attached to it, than a second and a third are founded on each side, parallel to the first, and so on till the hive is filled, the combs which were commenced first, being always in the most advanced state, and therefore the first completed.

102. The design of every comb is sketched out, and the first rudiments laid, by a single bee : this foundress-bee forms a block out of a rough mass of wax, drawn partly from its own resources, but principally from those of other bees, which furnish wax from the small sacks before described, taking out the plates of wax with their hind feet, and carrying it with their fore feet to their mouths, where it is moistened, masticated, and rendered soft and ductile.

103. The foundress-bee determines the relative position of the combs, and their distance from each other ; the foundations which she marks serving as guides to the ulterior labours of the wax-working bees, and of those which build the cells, giving them the advantage of the margins and angles already formed.

104. The mass of wax prepared by the assistants, is applied by the foundress-bee to the roof or bottom of the hive, and thus a slightly double-convex mass is formed : when of sufficient size, a cell is sculptured on one side of it by the bees, who relieve one another in the labour.

105. At the back, and on each side of this first cell, two others are sketched out and excavated : by this proceeding the foundations of two cells are laid, the line betwixt them corresponding with the centre of the opposite cells : as the comb extends, the first excavations are rendered deeper and broader ; and when a pyramidical base is finished, the bees build up walls from its edges, so as to complete what may be called the prismatic part of the cell.

106. The cells intended for the drones are considerably larger and more substantial than those for the workers ; and being formed subsequently, they usually appear nearer the bottom of the combs : last of all, are built the royal cells for the queens ; of these there are usually three or four, sometimes ten or twelve, in a hive, attached commonly to the central part, but not unfrequently to the edge of the comb.

107. The form of the royal cells is an oblong spheroid, tapering gradually downwards, and having the exterior full of holes : the mouth of the cell, which is always at the bottom, remains open until the maggot is ready for transformation, and it is then closed like the rest.

108. When a queen has emerged, the cell in which she was reared is destroyed, and its place supplied by a range of common cells : the site of this range may always be traced by that part of

the comb being thicker than the rest, and forming a kind of knot.

109. The common breeding cells of drones and workers are occasionally made the depositories of honey; but the cells are never made sufficiently clean to preserve the honey undeteriorated. The finest honey is stored in new cells, constructed for the purpose of receiving it, their form resembling precisely that of the common breeding cells: these honey cells vary in size, being larger or smaller according to the productiveness of the sources from which the bees are collecting, and also according to the season.

110. The cells formed in July and August being intended only for honey, are larger and deeper than those formed earlier: the texture of their walls is thinner, and thus they have more dip or inclination: this dip diminishes the risk of the honey's running out, which, from the heat of the weather at this season, and its consequent thinness, it is liable to do.

111. When the cells intended for holding the winter's provision are filled, they are always closed with waxen lids, and are never re-opened till the whole of the honey in the unfilled cells is expended: the waxen lids are thus formed:—the bees first construct a ring of wax within the verge of the cells, to which other rings are successively added, till the aperture of the cell is finally closed by a lid composed of concentric circles.

112. The flower-sleeping bee* is a wild species,† nearly black, and of small size : the male may be found throughout the summer, apparently fast asleep, in the blossoms of buttercups, and other flowers, or flying over them : the female is the very model of maternal industry, her whole life being spent in providing for her family.

113. This bee may be observed anxiously examining posts, rails, trellis-work, &c., especially on the sunny side : having found a part quite dry, and a little going to decay, she commences by piercing a hole nearly horizontally, about an inch deep ; then changing the direction, she proceeds as nearly in a perpendicular line as circumstances will allow : her strong jaws are the sole instruments with which nature has furnished her for this difficult task ; but with these she contrives to gnaw the wood to a sort of sawdust, which she kicks out behind her, passing it from one pair of feet to the next.

114. Occasionally she comes to the mouth of the hole,—it may be to rest herself, or to look round, and see that no enemies are near. The excavation, which, when finished, is cylindrical, and about ten or twelve inches long, is to be divided into nearly twenty cells, which are to be filled with food for her little ones, one of which will occupy each cell.

* *Chelostoma florissomne*.

† DELTA, in Entomological Magazine.

115. The egg which is first deposited will of course be the first to hatch, and become the first maggot; the first maggot will first become a chrysalis, and will also undergo the final change sooner than the younger part of the brood above.

116. To guard against the confusion which must necessarily arise from this, she continues the hole, changing its direction, until it assumes a horizontal course, and at length arrives again at the outside,—thus leaving an easy escape for the first of the brood, without disturbing those above, which will not appear till four or five days later.

117. She now closes the hole just above the lower bend with a partition consisting of fine sand, firmly glued together by means of a viscid saliva, with which she is copiously furnished: having stored a sufficient quantity of food, which consists of pollen, from the anthers, and honey from the nectaries of flowers, for the support of one larva, she deposits an egg, and then closes the cell in the same manner as she formed its bottom.

118. She then stores up more food, deposits another egg, and closes up another cell, proceeding thus until she has quite filled the perpendicular part of the hole. Her task now draws to a conclusion; she has only to close the two apertures: the lower one, intended for the outlet, is merely closed in the same way as the cells, with very fine sand; but as the upper one is much more exposed to danger from rain,

which might penetrate it, and, getting into the nest, destroy the young maggots, she uses first the fine sand, as before, and then adds a layer of larger grains.

119. Alighting on a gravel path, she selects a grain suited to her purpose, carries it to her nest, holding it in her mandibles, moves it about to find where it will fit best, and, covering it with saliva, presses it into its place, and flies off for another and another, till the aperture is securely closed, and her labour done: she has provided for the continuance of her race; and, with her care, ends also her life.

CHAPTER VII.

HISTORY OF THE ICHNEUMON.

Class	Hymenoptera.		Genus	Pimpla.
Order	Ichneumonites.		Species.....	Instigator.

120. THERE are many butterflies and moths which increase so rapidly, that, without a check, their caterpillars would, in two or three years at the utmost, devour every green leaf on the face of the earth, and render it incapable of supporting its present inhabitants.

121. The ichneumons are evidently created to act as a check to this devastation : they are generally small insects, with slender bodies, and have four transparent wings : they are very active, running about the stems and leaves of plants in search of caterpillars, and fly very readily.

122. The ichneumons are of many kinds : more than a thousand varieties have been described by naturalists ; and it is supposed that every butterfly, and every moth, indeed, almost every insect, has one peculiar to itself : the history of them all is nearly similar.

123. The caterpillar of the tiger-moth is one of the most destructive in our gardens ; it devours, indiscriminately, lettuces, radishes, beans, peas, and every other early produce of our gardens, and is most abundant in the spring, when these plants are being reared : it is a very rough hairy caterpillar, black above, with a red fringe on each side : it is preyed on by several ichneumons.

124. The largest ichneumon (*Pimpla Instigator*) of the tiger-moth (*Arctia caia*) is often about an inch long, but is of very various size ; it has a black body and red legs, and has a remarkably strong smell, something like burning pitch.

125. In the spring, this ichneumon may be seen coursing over the leaves of lettuces, in currant bushes, on strawberry beds, nettles, &c. hunting for the object of its attack.

126. When it has found a caterpillar, it seizes it behind the head with its jaws, at which operation the caterpillar looses its hold of the plant on which it was feeding, rolls itself suddenly in a ring, erects its bristles as stiffly as possible, and falls on the ground ; if the fall is far, and among twigs, the ichneumon is sometimes dislodged, but this rarely happens.

127. The female ichneumon has three bristles at its tail, of which the middle one appears to be a tube for conveying its eggs into the body of the

caterpillar, and is called an ovipositor; the outer ones seem to serve as protectors to this ovipositor, and not to be used for piercing the caterpillar.

128. When the caterpillar can fall no further, it frequently unfolds itself, and writhes about to dislodge its enemy; but its struggles are useless: the ichneumon elevates its body in a kind of arch, bending the ovipositor forward beneath it nearly to its mouth; it then steadies the ovipositor by its hind legs, and, with a slight jerk, drives it into the skin of the caterpillar behind its head; the egg is instantly deposited, the ovipositor withdrawn, and the ichneumon flies away.

129. The caterpillar, immediately on the conclusion of this operation, remounts the plant on which it had previously been, and begins feeding eagerly as before; no difference whatever is to be discovered in its manner, in the quantity of food it consumes, or in the rapidity of its growth.

130. When the caterpillar has attained its full size, it spins a web among leaves, on the ground, in a bush, or against palings, intermixing a considerable quantity of its own hairs; and in this web it becomes a chrysalis.

131. The egg of the ichneumon is very soon hatched, and becomes a white maggot, without feet and with very little appearance of head; it begins eating that part of the flesh of the caterpillar which is immediately in its neighbourhood, and continues

its course towards the tail, devouring all the fat and muscular parts not absolutely essential to motion and life; and, by the time the caterpillar of the moth is full grown, and changes to a chrysalis, the maggot of the ichneumon is full grown also, and occupies more than half of its interior.

132. It is worthy of remark, that this maggot thus inhabiting for weeks the body of a living caterpillar, and devouring its living flesh, always instinctively avoids those parts which are essential to life, as though aware that the cessation of life in the caterpillar would ensure its own death, as it could not subsist on the putrifying carcase.

133. After laying quiescent for many days, and often weeks, and sometimes through the whole winter, the skin of the maggot is thrown off, and it becomes a chrysalis, exhibiting very exactly the shape and appearance of the future fly; the antennæ and legs being placed before it, the wings small, and folded by its side, and the ovipositor being turned up a little over its back.

134. The chrysalis is without motion, and much resembles that of the bee: in both instances the limbs are quite distinct from the body, and not united with it in a hard crustaceous case, as is the case in the chrysalis of the silk-worm: this kind of chrysalis is said to be necromorphous (*pupa necromorpha*), from its resemblance to the perfect insect, with its limbs neatly arranged, and motionless, as in death.

135. The chrysalis state lasts but a few days, and the perfect insect emerges from it; after this first escape, it has to penetrate the shell of the chrysalis of the tiger-moth, in which it is still imprisoned, and which is made much harder by the drying of the portions of animal matter which the maggot of the ichneumon had left unconsumed.

136. The ichneumon overcomes this difficulty by gnawing a hole with its sharp and strong jaws, generally in that thin portion of the shell which covers the wing of the future insect: almost immediately on emerging, the ichneumon vibrates its wings and flies away.

137. The caterpillar of the tiger-moth is preyed on in a similar manner by the maggot of a two-winged fly; and this maggot, while thus devouring the interior of the caterpillar, is itself a prey to a minute kind of ichneumon, twenty of which sometimes feed in the maggot of a single fly.

138. The manner in which the egg of this little ichneumon is introduced into the maggot of the fly, is at present unknown; but as the fly fastens its egg exteriorly on the skin of the caterpillar, and does not perforate the skin, and deposit it inside, as in the case of the great ichneumon before described, it is supposed the small ichneumon's egg is laid in the egg of the fly while the latter is adhering to the skin of the caterpillar.

139. The egg of the fly, which is placed on the neck of the caterpillar, the only part from which the caterpillar could not remove it, is very conspicuous to an observer: in this situation, we cannot wonder, then, the little ichneumon should discover it; nor does it appear an improbable supposition, that the little creature seizes this opportunity of piercing its shell with her oviduct, and depositing her egg amidst its contents.

140. The maggot of the fly, as soon as hatched, pierces the skin of the caterpillar, and commences devouring, carrying within it a horde of insidious parasites, which, though they interfere not with the due performance of its appointed work of destruction, yet, in the end, so weaken it, that it never arrives at perfection.

141. Ichneumons of different kinds attack the eggs, larvæ, chrysalides, or imagines, of nearly all insects; and very ingenious experiments and calculations have proved, that four out of every five eggs that are laid, are prevented from arriving at maturity by parasites attacking them in one or other of these stages.

CHAPTER VIII.

HISTORY OF THE BURYING-BEETLE.*

Class.....	Colcoptera.	Genus.....	Necrophorus.
Order	Silphiites.	Species	Vespilly.

142. THE burying-beetle is about an inch in length; it is black, with two bands across its back of a bright orange colour; these bands are formed by two large blotches on each of the upper wings: though in such a gay dress, it is a disgusting insect, being so fœtid that the hands smell for hours after handling it; and if it crawls on woollen clothes, which are not washed, the smell continues for days.

143. The burying-beetle lays its eggs in the bodies of putrefying dead animals, which, when practicable, it buries in the ground. In Russia, where the poor people are buried but a few inches below the surface of the ground, the burying-beetles avail themselves of the bodies for this

* From Rusticus' MS.; with permission.

purpose, and the graves are pierced with their holes in every direction ; at evening, hundreds of these beetles may be seen in the church-yards, either buzzing over recent graves, or emerging from them.

144. The burying-beetle in this country seldom finds so convenient a provision for him, and he is under the necessity of taking much more trouble ; he sometimes avails himself of dead dogs and horses, but these are too great rarities to be his constant resort : the usual objects of his search are dead mice, rats, birds, frogs, and moles ; of these, a bird is most commonly obtained.

145. In the neighbourhood of towns, every kind of garbage that is thrown out attracts these beetles as soon as it begins to smell ; and it is not unusual to see them settling in our streets, enticed by the grateful odour of such substances.

146. The burying-beetles hunt in couples, male and female ; and when six or eight are found in a large animal, they are almost sure to be males and females, in equal numbers : they hunt by scent only, the chase being mostly performed when no other sense would be very available, viz. in the night.

147. When they have found a bird, great comfort is expressed by the male, who wheels round and round above it, like an eagle,—the female settles on it at once, without this testimonial of satisfaction ; the male at last settles

also, and the bird undergoes the scrutiny of four, at least, of the senses,—touch, smell, sight, and taste,—for their heads are continually diving among the feathers of the bird, and a savoury and ample meal is made before the great work is begun.

148. After the beetles have appeased the calls of hunger, the bird is abandoned for a while; they both leave it to explore the earth in the neighbourhood, and ascertain whether there is a place suitable for interment: if on a ploughed field, there is no difficulty; but if on grass, or among stones, much labour is required to draw it to a more suitable place.

149. The operation of burying is performed almost entirely by the male beetle, the female mostly hiding herself in the body of the bird about to be buried, or sitting quietly upon it, and allowing herself to be buried with it: the male begins by digging a furrow all round the bird, at the distance of about half an inch, turning the earth outside; his head is the only tool used in this operation; it is held sloping outwards, and is exceedingly powerful.

150. After the first furrow is completed, another is made within it, and the earth is thrown into the first furrow: then a third furrow is made, which, being under the bird, the beetle is out of sight: now the operation can only be traced by the heaving of the earth, which soon forms a

little rampart round the bird ; as the earth is moved from beneath, and the surrounding rampart increases in height, the bird sinks. After incessant labour for about three hours, the beetle emerges, crawls upon the bird, and takes a survey of his work.

151. If the female is on the bird, she is driven away by the male, who does not choose to be intruded on during the important business. The male beetle then remains for about an hour perfectly still, does not stir hand or foot ; he then dismounts, diving again into the grave, and pulls the bird down by the feathers, for half an hour : its own weight appears to sink it but very little.

152. The earth then begins heaving and rising all round, as though under the influence of a little earthquake : the feathers of the bird are again pulled, and again the bird descends. At last, after two or three hours' more labour, the beetle comes up, again gets on the bird, and again takes a survey, and then drops down, as though dead, or fallen suddenly fast asleep.

153. When sufficiently rested, he rouses himself, treads the bird firmly into its grave, pulls it by the feathers this way and that way, and, having settled it to his mind, begins to shovel in the earth : this is done in a very short time, by means of his broad head. He goes behind the rampart of earth, and pushes it into the grave with amazing strength and dexterity ; the head being bent

directly downward at first, and then the nose elevated with a kind of jerk, which sends the earth forwards.

154. After the grave is thus filled up, the earth is trodden in, and undergoes another keen scrutiny all round, the bird being completely hidden; the beetle then makes a hole in the still loose earth, and having buried the bird and his own bride, next buries himself.

155. The female lays her eggs in the carcase of the bird, in number proportioned to its size; and after this operation is over, and the pair have eaten as much of the savoury viand as they please, they make their way out, and fly away in quest of further adventures.

156. The eggs are hatched in two days, and produce flat scaly grubs, which run about with great activity; these grubs grow excessively fast, and very soon consume all that their parents had left. As soon as they are full grown, they cease eating, and burrowing further in the earth, become pupæ. The length of time they remain in this state appears uncertain; but when arrived at the perfect state, they make round holes in the ground, from which they come forth.

CHAPTER IX.

HISTORY OF THE APPLE WEEVIL.*

Class.....	Coleoptera.	Genus.....	Anthonomus.
Order	Cureulionites.	Species	Pomorum.

157. THE apple weevil is frequently in Herefordshire the cause of the total failure of the crop of apples, and of a consequent heavy loss to the grower; it is a small beetle, about half the size of a grain of wheat, of a reddish brown colour, with the appearance of a letter V obscurely chalked on its back.

158. With the first sunshiny day in March, these weevils leave their winter quarters,—the crevices in the bark,—crawl up the trunk along the twigs, perch themselves so as to receive the full benefit of the sun's rays, and plume themselves all over in the same manner that a cat washes her face with her hands, stretch their limbs one at a time, unfold their wings, and fly away in search of their consorts.

* From *Ruslicus*, in *Entomological Magazine*.

159. By the time the female weevil is ready for the important task of depositing her eggs, the spring has considerably advanced; the apple buds have burst; and the little bunches of blossom are readily to be distinguished. The weevil soon finds out these, and selecting a blossom every way to her mind, commences her operations.

160. The beak, or trunk of the weevil, is a curious instrument; it is very long, and, from each side of it, springs a feeler, which bends forwards at a right angle, so that it appears to be three-pronged, like a trident; it is furnished at the extremity with short teeth, or mandibles.

161. With these teeth the female weevil gnaws a very minute hole into the calyx of the future blossom, and continues gnawing until the trunk is plunged in up to her eyes; the trunk is then withdrawn, and the hole carefully examined by the introduction of one of the feelers: if it requires alteration, the trunk goes to work again, and again the feelers.

162. Being at last fully satisfied that the work is well accomplished, she turns about, and, standing with the extremity of her abdomen over the hole, thrusts into it her long ovipositor, an instrument composed of a set of tubes, retractile one within the other, and deposits a single egg (never more) in the very centre of the future flower: another examination with her feeler now takes place, to ascertain that all is right, and away she flies to

perform the same task again and again, never tiring while there is an egg to lay.

163. The bud continues to grow like the other buds: the little perforation becomes invisible. By and by the egg bursts, and out comes a little white maggot, without legs, which, directly it is hatched, begins to devour the young and tender stamens; next to these the style is attacked, and eaten down to the fruit, the upper part of which is quickly consumed. The maggot is then full fed; it casts its skin, becomes a chrysalis, and lays perfectly still.

164. Up to this time the blossom has continued perfectly healthy, no trace of the enemy being discovered without; but when the neighbouring blossoms are expanding their petals to the genial breath of spring, those of the mutilated bud remain closed, and retain the arched balloon-like appearance of a bud about to burst. For a few days they preserve their lovely pink colour, and then, by degrees, fade to a dingy brown.

165. On opening these brown, or rather rust-coloured blossoms, about the 10th to the 15th of June, the chrysalis will be found to have changed to a perfect beetle, similar to its parent, which, had it been left to itself, would, in a few days, have eaten its way through the weather-beaten case of dried petals, and left its prison-house, flying about to take its pleasure till the chilly winds of autumn should drive it to its winter habitation.

CHAPTER X.

HISTORY OF THE EARWIG.

Class.....	Orthoptera.	Genus.....	Forficula.
Order	Forficulites.	Species	Auricularia.

166. THE earwig is one of our most common insects; it is well known to every one, and is very generally an object of unconquerable dislike; the forceps at its tail, and the threatening manner in which these are turned over its back to pinch any thing of which it is afraid, render it peculiarly disgusting.

167. The fore wings of the earwig are square, short, leathery pieces, which cover but a very small portion of the body: the insect is incapable of bending or folding them in any direction, or of using them as organs of flight.

168. The hind wings of the earwig are very different from the fore wings. They are folded into a very small compass, and covered by the fore wings, except a small portion which protrudes

from beneath them ; and, when examined in this position, appear totally useless as organs of flight.

169. When unfolded, the hind wings are remarkably beautiful ; they are of ample size, perfectly transparent, displaying prismatic colours when moved in the light, and are intersected by veins, which radiate from near the centre to the margin.

170. The shape of these wings, when fully opened, is precisely that of the human ear ; and from this circumstance, it seems highly probable that the original name of this insect was *earwing*, and not *earwig*, which appears to be entirely without a meaning.

171. Earwigs subsist principally on the leaves and flowers of plants, and on fruit, and they are entirely nocturnal insects, retiring by day into dark crevices and corners, where they are screened from observation. The rapidity with which they devour the petals of a flower is remarkable : they clasp the edge of a petal in their fore legs, and then, stretching out their head as far as possible, bite out a mouthful ; then another mouthful nearer, and so on till the head is brought to the fore legs.

172. This mode of eating is exactly that which is used by the caterpillars of butterflies and moths ; the part of the leaf or petal is eaten out in a semicircular form, and the head is thrust out to the extreme part after every series of mouthfuls.

Pinks, carnations, and dahlias, very frequently lose all their beauty from the voracity of these insects.

173. When the time of breeding has arrived, which is generally in the autumn, the female retires for protection to the cracks in the bark of old trees, or the interstices of weather-boarding, or under heavy stones on the ground: here she makes a smooth place, and commences laying her eggs.

174. The eggs are usually from twenty to fifty in number: when she has finished laying them, she does not forsake them, as is the habit of other insects, but sits on them in the manner of a hen until they are hatched.

175. When the little ones leave the shell, they are instantly very perceptibly larger than the eggs which contained them. They precisely resemble the parent in structure and habit, except that they are without wings; and they differ also in colour, being perfectly white.

176. The care of the mother does not cease with the hatching of the eggs: the young ones run after her wherever she moves, and she continues to sit on them and brood over them with the greatest affection for many days.

177. If the young ones are disturbed or scattered, or if the parent is taken away from them, she will, on the first opportunity, collect them again, and brood over them as carefully as before,

allowing them to push her about, and cautiously moving one foot after another for fear of hurting them.

178. How the young ones are fed until the mother's care for them has ceased, does not seem to have been ascertained ; for it is not until they are nearly half grown that they are seen feeding on vegetables with the rest.

CHAPTER XI.

HISTORY OF THE LOCUST.*

Class	Orthoptera.	Genus	Locusta.
Order.....	Locustites.	Species	Migratoria.

179. THE locust, from the remotest ages, has had a greater power to injure man, than any other living creature. Its course is almost invariably accompanied with famine and pestilence : man is armed with no power to resist it.

180. The locust was sent as a plague to the Egyptians, especially to punish them for the detention and oppression of the Israelites : the whole face of the country was covered by their multitudes.

181. Afterwards, about the date B. c. 200, we have it on record, that locusts again swarmed in the same part of Africa.

182. St. Augustin mentions another enormous swarm in the same region, which devoured every

* From Kirby and Spence's Introduction to Entomology.

green leaf, and eventually reaching the sea, perished by drowning; and the mass of their corrupted bodies created so great a stench, that a pestilence ensued, which carried off nearly a million human beings.

183. We are told by Mouffet, that in the year 591 a swarm of locusts visited Italy; they pursued their destructive course, devouring every thing, until they reached the sea, in which they perished. The pestilence arising from the stench carried off men and beasts to the number of more than a million.

184. In 1478, the Venetian territory was visited by a swarm of locusts, which so completely destroyed the crops as to cause a famine, in which more than thirty thousand persons died of starvation.

185. In 1650, a swarm of locusts entered Russia. As they passed, the air was darkened by their numbers; they covered the face of the earth; the trees bent with their weight; and in places the mass of their dead bodies was four feet in depth.

186. In 1748, a swarm of locusts visited the Austrian dominions: at Vienna the breadth of the swarm exceeded three miles, and so darkened the air, that one person could not see another at the distance of twenty paces.

187. Major Moor witnessed in the Mahrattas the ravages of a swarm of locusts, that was five

hundred miles in length, and so compact as completely to hide the sun, and occasion darkness.

183. Mr. Barrow relates that, in Southern Africa, in the years 1784 and 1797, a swarm of locusts covered an area of nearly two thousand square miles. When driven by a north-west wind into the sea, they formed upon the shore, for fifty miles, a bank three or four feet high: the stench from their putrefying bodies was perceptible at the distance of one hundred and fifty miles.

189. In 1778 and 1780, a swarm of locusts visited Morocco; every green thing was eaten, and a dreadful famine ensuing, such vast numbers of people died of hunger in the streets of the towns, that their bodies lay unburied.

190. The egg of the locust is deposited in the ground; when it is hatched, it has all the appearance of a locust in miniature, except that it is without wings. Its work of destruction immediately commences; it devours every blade of grass, every green leaf that it can obtain.

191. In the autumn it assumes the winged state, and then myriads assemble, and having stripped the earth of its mantle of green, rise in the air, and are driven by the wind, carrying with them destruction, famine, and pestilence.

192. The shape and appearance of the locust is that of our commonest grasshopper, but it greatly exceeds that insect in size; it leaps with

ease and agility, but, excepting in its migrations, does not readily fly.

193. The jaws of the locust are excessively hard and strong, capable of devouring not only the leaves, but, when these fail, the bark and even the solid wood of trees. The sound of their feeding, when in swarms, is as the rushing of flames driven by the wind.

194. Happily in this country the locust is very rare; it has occasionally been driven here by winds, but has never been known to breed here. In the year 1748, a considerable number were observed, but not enough to do any serious injury.

CHAPTER XII.

HISTORY OF THE COCCUS OF THE VINE.*

Class	Hemiptera.	Genus.....	Coccus.
Order.....	Coccites.	Species	Vitis.

195. OUR vines are often disfigured, and sometimes rendered unfruitful, by an insect which is called the vine-gall, or vine-coccus. The injury it causes to the vines is occasioned by perforating the tender rind, and thus causing the sap to flow, or, as the gardeners usually term it, making the vines bleed.

196. Our climate is not usually hot enough for this insect to increase to any alarming extent on our out-door vines; but in hot-houses it breeds in incredible numbers, often doing great mischief: sometimes it is so abundant that the young shoots appear to be covered with white cotton, which is in reality a resinous gum, exuded from the cocci in a filamentous form.

* FROM RUSTICUS' MS. with permission.

197. The coccus pierces the bark by means of a sharp and long under lip, which penetrates the shoot to the very centre, causing the sap to flow in great abundance: this piercing apparatus, though, like the mouth of other insects, in the head, is bent so far under the breast that it appears to proceed from that part, and is generally so described.

198. The cocci, in the young or larva state, are all alike; they appear like little tortoises fixed to the rind, and sometimes leaves of the vine. When the period for this state is over, the males burst their skins along the back, and fly away: the females undergo no change in form on arriving at perfection, nor do they become locomotive.

199. The male and female coccus are remarkably different, not only in size but structure: the male is a small, active, two-winged fly; the female is a large, inactive, and apparently lifeless lump, twice the size of the male, without wings, and so closely attached to the rind of the young shoots on which it feeds, that it cannot be removed without causing its death.

200. When the female has attained this immense size, and her whole body is full of eggs, she begins laying them, her body being glued down all round at the edges to the rind of the twig; but between her body and the rind, except just round the edges, is a quantity of the cottony gum

spread over the whole area which she covers. The laying of eggs is on a different system to that of any other insect.

201. The first egg is laid in the cottony substance, without causing any disturbance to the points of attachment to the rind. It does not stick, as most other insects' eggs do, but lies quite loose in the cotton; then another is laid, which pushes the first a little further forwards; and then another and another, none of them being visible from without; so that all the eggs the female lays she may be said to sit on like a hen, for that is really the case.

202. The female, as we often find to be the case in insects, is, when arrived at perfection, a complete bag of eggs. Now it will be observed, that as she lays them, and then pushes them under her body, they must raise up the under skin of her body into a manifest concavity; thus the body itself becomes daily thinner and thinner, and the pile of eggs concealed by it thicker and thicker.

203. The rapidity with which the eggs are laid is surprising. If the female has been forcibly separated from the twig to which she was attached, and suspended on a pin, while at the height of her laying, a string of eggs, all attached, like a delicate necklace, an inch and three quarters in length, has been found in a single night, although the coccus exhibited no other symptoms of life.

204. At last, when the eggs are exhausted, the under skin of the body meets the upper skin, and adheres to it; the mother dies; and her body, like the roof of a house, protects the inhabitants below from the inclemency of the weather.

205. After a few days from the death of the mother, the eggs hatch, and become lively little animals, of a bright red colour; these devour the cottony gum among which they are born: after a few days, they manage to lift up the edge of their covering, and away they run, helter-skelter. This active life lasts but a short time; they soon get hungry, pierce the rind of the twigs, anchor themselves by the beak, and, settling down to serious eating, become fixtures for life.

CHAPTER XIII.

HISTORY OF THE HOP-FLY.*

Class.....	Hemiptera.	Genus.....	Aphis.
Order	Aphites.	Species	Humuli.

206. THE crop of hops is entirely dependent on a little, and apparently insignificant fly, well known to hop growers under the name of the hop-fly.

207. The duty on hops is a considerable source of revenue to the British Government: when the hop-fly has been unusually numerous, the whole duty on hops throughout the kingdom has amounted only to 15,000*l.*; when, on the contrary, the fly has not appeared, the duty has been 468,000*l.*: this little insect thus appears capable of abstracting from the British treasury 453,000*l.* per annum.

208. The duty, 18*s.* 8*d.* per cwt., is but about a sixth part of the value of hops; so that the real sum over which this little creature exercises its influence is at least 2,700,000*l.* per

* RUSTICUS, in the Entomological Magazine.

annum; and this amount, owing to unceasing speculation, changes hands many times in the year.

209. The principal hop counties in England are Kent, Sussex, Surrey, Worcester, and Hereford. The hops grown at Farnham, in Surrey, fetch the highest price.

210. The hop-fly makes its first appearance in May, generally about the 12th, and always between the 10th and 30th; it is remarkable that it mostly appears on the same day in all the hop districts, however distant.

211. The hop-fly makes its first appearance in the winged state, a solitary fly being found settled here and there on the under side of the young leaves; if the weather is warm, with mild rains during the last twenty days of May, these flies produce young ones, which are very small, and are called *deposit*, or *knits*: these grow very fast, and, in a few days, become green *lice*, which is merely a larger form of the same animal.

212. As soon as these creatures are born, they insert their tube-like mouth into the leaf of the hop, and begin sucking its sap: in this position they remain fixed and stationary, daily increasing in size for about ten days; and then each individual, without either love, courtship, or matrimony, begins bringing forth young ones, and continues to do so at the rate of about eighteen per day all the remainder of its life.

213. The parent still continues growing; and

the young ones being so much smaller, and fastening themselves close by their respective parents, remind one of a flock of sheep, with oxen here and there scattered among them ; if the weather continues warm and moist, they increase so fast as completely to cover the plant, deprive it of life, and frequently perish with it.

214. It is seldom until September that many of the hop-flies attain the winged state : they then wing their way over the country, floating in the sunbeams, till, tired of the sport, they seek a safe winter habitation beneath the bark of trees, shrivelled leaves, the cracks of hop-poles, and a thousand other secure hiding-places.

215. Frequently, when the weather in May has been dry, and cold, and windy, the hop-fly has been known to leave the plant, and entirely disappear, even after remaining several days ; yet, whilst it tarried, showing very evident signs of being uneasy, continually crawling about on the upper, as well as the under side of the leaves, and leaving no deposit whatever.

216. The hop-fly is eagerly sought as food by various other insects ; which, though they consume immense numbers, seem to cause no sensible diminution in their countless myriads.

217. The principal enemy of the hop-fly is a queer looking creature, like a fat lizard ; it feeds on them most voraciously, a single individual devouring forty or fifty in the course of a day :

it turns to the common lady-bird, or lady-cow, a pretty little beetle, which always preys in the same way.

218. Another enemy of the hop-fly, is a green ungainly looking grub, without legs, which lays flat on the surface of the leaf, and stretches out its neck, just like a leech, till it touches one of them; directly he feels one, he seizes it in his teeth, and holds it up wriggling in the air till he has sucked all its juices, and left it a mere empty skin.

219. This curious creature turns to a fly, which has a body banded with different colours; and which, in summer, may be often observed under trees and about flowers, standing quite still in the air, as though asleep; yet, if you try to catch it, darting off like an arrow: the fly is called *Syrphus balteatus*.

220. A third enemy of the hop-fly has six legs, and very large, strong, curved jaws, and is a most ferocious looking animal, frequently parading about a leaf, covered with the skins of the hop-flies which he has destroyed: this fierce creature comes to a very beautiful fly, with four reticulated wings and two brilliant golden eyes; it smells very unpleasantly.

221. A fourth enemy to the hop-fly, is a minute ichneumon, similar to that which is parasitical of the blight of the rose: the males of these ichneumons are active, flying about, and coursing over the leaves; but the female is of less roving

habits, and will generally be found busy in providing for the establishment of her numerous progeny: placed, at her birth, among myriads of hop-flies, she has no dwelling to construct with artful industry, nor stores of food to collect by distant roving.

222. With extended antennæ, and wings shivering with desire, she paces leisurely amongst the defenceless herd; and as soon as she has selected one by a light touch of her antennæ, she stops short at about her own length from it, and rising on stiffened legs, bends her body under her breast till the end of it projects beyond her mouth; then erecting her back by depressing the hinder part, she simultaneously makes a lunge forward with the body, which is then extraordinarily lengthened, and, by a momentary touch, deposits an egg on the under-side of the hop-fly, near its tail.

223. The hop-fly will sometimes kick and sprawl, so as to discompose the ichneumon; but being anchored by its sucker plunged in the bark, can make no effectual attempt to elude the deadly weapon: should it, however, be wandering at large, and free to struggle, she shews great activity, by traversing round it in the attitude of attack, till she can take it in flank.

224. The delicate sense of the antennæ seems to warn her where a germ has been already deposited, as she will pass by those which have been stung some days before; and there is never

found more than a single grub in each individual : when all the interior of the hop-fly is consumed by the grub of the ichneumon, it will be found separate from its fellows, and motionless, usually on the upper side of the leaf, to which it is glued by some viscid exudation.

225. The hop-fly now appears distended, and of an opaque hazel or lighter tint ; if opened, the full fed grub of the ichneumon will be discovered doubled up and filling the cavity, its head being next the tail of the hop-fly : in a short time the parts of the perfect insect are developed in a quiescent state, and in the same position, the integuments of the grub being doubled up below it in black grains : it spins no cocoon, being adequately protected by the indurated skin of its victim.

226. A few days are sufficient to give consistence to its parts ; and while the new-risen sun is yet glistening in the early dews, the winged insect, by a push of its head, detaches the latter rings of its case, which separate in the form of a circular lid, often springing back to close the orifice after the inhabitant has gone forth, born in the maturity of her energies and instincts to renew the circle of existence.*

* The account of this parasite is copied from Mr. Haliday's Essay on Parasitic Hymenoptera, in the Entomological Magazine : the author has witnessed precisely the same facts, in regard to the hop-fly, which Mr. Haliday relates of the aphid of the rose.

CHAPTER XIV.

HISTORY OF THE ANT-LION.*

Class.....	Neuroptera.	Genus	Myrmeleon.
Order	Myrmeleonites.	Species.....	Formicaleo.

227. THE ant-lion is a native of Portugal, Spain, France, Italy, and Turkey, and, probably, of most of the tropical countries: it is a large fly with four long wings, beautifully reticulated, like those of a common dragon-fly.

228. The egg is laid by this fly on the surface of the ground, or just below it, in sandy and loose soils; the heat of the sun soon causes it to hatch and produce a larva.

229. The larva, in shape, has a slight resemblance to a wood-louse; but the outline of its body is more triangular, the anterior part being considerably wider than the posterior: it has six legs, and the mouth is furnished with a pair of forceps, consisting of two incurved jaws, which give it a formidable appearance.

* From KIRBY and SPENCE's Introduction to Entomology.

230. Its sole food is the juices of other insects, particularly ants ; at first view it seems scarcely possible that it should ever procure a single meal : not only is its pace slow, but it can walk in no other direction than backwards ; its grim aspect, combined with this awkwardness in progression, appear to offer insuperable obstacles to the capture of its prey.

231. Its first step is to trace in the sand a circle, the destined boundary of its future abode : this being done, it proceeds to excavate the cavity by throwing out the sand by a process not less singular than effective.

232. Placing itself in the inside of the circle which it has traced, it thrusts the hind part of its body into the sand, and with one of its fore legs, serving as a shovel, it charges its flat and square head with a load, which it immediately throws over the outside of the circle, with a jerk sufficiently strong to carry it many inches.

233. Walking backwards, and constantly repeating the process, it soon arrives at the part of the circle from which it set out : it then traces a new circle within the first, and excavates a second furrow ; then a third within this, and so on until, by a repetition of these operations, it arrives at the centre.

234. It never loads its head with the sand lying on the outside of the circle, though it would be as easy to do this with the outward leg,

as to remove the sand within the circle with the inner leg ; but it knows that it is the sand within the circle that is to be excavated, and it therefore constantly uses the leg next the centre.

235. After the first series of circles is completed, a second, of less diameter, and deeper, is commenced within it ; and so on with others, until the hole assumes the shape of the impression of an inverted cone, when the work is finished.

236. As the constant use of one leg during the whole of this operation would necessarily exhaust the animal so much that it would be compelled to waste much time in recovering its strength, it adopts a plan which prevents this : the first circle is excavated with one foot ; it then turns completely round, so that the second is excavated with the opposite foot ; and this alternation proceeds regularly through the whole work.

237. Small stones are jerked out by its head in the same manner as the sand, but larger ones occasion more trouble : when it meets with one too heavy to jerk out, the ant-lion poises it on its back, keeps it in a steady position by the motion of the segments of its body, and carefully walking up the ascent with its burden, deposits it on the outside of the margin.

238. Sometimes the stone, from its roundness, will slip from the back of the labourer, and roll down the side of the hole a dozen times ; as often

does the patient creature renew the task, and never fails to accomplish it at last: but if a large or immovable stone obstructs its way, the work is abandoned, and a more suitable spot selected, and another hole is forthwith commenced.

239. The hole is rather more than two inches deep; the length of the ant-lion is about half an inch. When the hole is ready, the ant-lion buries itself in the sand at the bottom, its jaws alone being visible, and in this position waits quietly the arrival of its prey.

240. It is not long before an ant, or some other insect, steps on the margin of the pit, either accidentally, or to examine its contents; the pulverized sand slides from under its feet, its struggles but hasten its descent, and it is precipitated headlong into the jaws of the concealed devourer.

241. Sometimes, especially after rain, when the particles of sand adhere to each other, the intruding insect is able to arrest its downward progress, and begins to scramble up again; no sooner does the ant-lion perceive this, than he shovels loads of sand on his head, and throws them with such skill on the poor ant, or whatever insect it may be, that it is soon overcome and carried to the bottom.

242. The insect, when caught, is pierced by the strong jaws of the ant-lion, and its juices sucked until nothing but an empty shell is left; this it jerks out of the pit to a considerable

distance, as if to avoid giving any cause of alarm to any new comers.

243. After a period of nearly two years, its full growth being attained, it retires further below the sand, spins a silken cocoon, and changes into a chrysalis, in which state it remains about three weeks, after which time it emerges a perfect insect.

CHAPTER XV.

HISTORY OF THE WHITE ANT.*

Class.....Neuroptera. | Order.....Termites
Genus.....Termes.

244. THE white ants may be reckoned, next to the locusts, the most destructive insects known to man; not merely articles of food, but clothing, fences, trees, and even houses, are doomed to fall before them.

245. The white ants live in immense communities, consisting of a king and queen, soldiers and labourers; the king and queen are the perfect insect, male and female; the soldiers are said to be the pupa state, and the labourers, the larva state of the same insect.

246. It is the only office of the king and queen to increase their kind, the queen laying eggs to the amount of eighty thousand every day.

247. It is the office of the soldiers to attack every object or living thing that in any way

* From KIRBY and SPENCE's Introduction to Entomology, abridged by those authors from Smeathman.

injures or endangers the safety of the nest ; this duty they perform with the most reckless bravery, the labourers retiring within the nest during the time of danger.

248. The offices of the labourers are manifold : they take the eggs from the queen as fast as she lays them, convey them to the nurseries, tend them till hatched ; they feed the young, they store provisions, build the nest, repair damages, and perform every kind of labour requisite for the good of the community.

249. The nests of the white ants are formed entirely of clay ; they are about twelve feet high, and broad in proportion. The first step in the erection of these structures is the elevation of two or three turrets, about a foot high, and in shape like a sugarloaf.

250. These turrets rapidly increase in number and height, until at length being widened at the base, joined at the top into one dome, and consolidated all round into a thick wall of clay, they assume the shape of a haystack, which soon becomes clothed with grass.

251. When the building has assumed this its final form, the inner turrets, all but the tops, which project like pinnacles from different parts of it, are removed, and the clay is used for other purposes.

252. The upper portion, or dome, which is very strong and solid, serving as a defence from the weather and the attacks of enemies, is left empty :

it is the lower part only of the building that is inhabited.

253. The inhabited portion is occupied by the royal chamber, or habitation of the king and queen, the nurseries for the young, the storehouses for the food, and innumerable galleries, passages, and empty rooms.

254. In the centre of the building, just under the apex of the dome, and nearly on a level with the surface of the ground, is the royal chamber, an arched vault of a semi-oval shape, at first not more than an inch in length, but enlarged as the queen increases in bulk, to the length of eight inches or more.

255. In this apartment the king and queen constantly reside; and by the smallness of the entrances, which will only admit their much more diminutive subjects, they are prevented from ever emerging.

256. Immediately adjoining the royal chamber, and completely surrounding it, to the extent of more than a foot, are the royal apartments, a number of arched rooms of various shapes and sizes, either opening into each other, or communicating by passages; these are occupied by a guard of soldiers and the attendant domestics, thousands of whom are ever waiting on the royal pair.

257. Beyond the royal apartments are the nurseries and magazines; the nurseries are occupied

by the eggs and young, and the domestics in waiting on these: in substance they differ from the other apartments, being composed of triturated wood cemented by gum.

258. A collection of these compact, irregular, and wooden chambers, not one of which is half an inch in length, is enclosed in a common chamber of clay, sometimes as large as a child's head.

259. Intermixed with the nurseries are the magazines, which are chambers of clay, always well stored with provisions, consisting of particles of wood, gums, and the inspissated juices of plants.

260. These nurseries and magazines are separated by small empty chambers and galleries, which run round them, or communicate from one to the other, and are continued on all sides to the outer wall of the building, reaching up within it to two-thirds or three-fourths of its height.

261. The magazines and nurseries are confined to the sides of the hill, leaving an open area in the middle under the dome, the roof of which is supported by Gothic arches, of which those nearest the middle are from two to three feet in height, but those towards the sides are much lower.

262. A flattish roof, impervious to wet, covers the top of the assemblage of nurseries and magazines, protecting them in case the dome suffers any injury; and the area above the royal chamber has a flattish roof, also waterproof, and so contrived as to allow any wet that by chance

gains admittance, to pass off into subterraneous passages.

263. These passages, some of which are a foot in diameter, and perfectly cylindrical, are lined with clay. They originally served as quarries, whence the materials of the building were derived, and afterwards as the galleries by which the inmates travel under ground, to carry on their depredations at a distance from their home.

264. These galleries run slantingly downwards to the depth of two or three feet, then branching out in every direction, rise nearly to the surface, and are carried under ground to an almost incredible distance.

265. There are numerous minor galleries intersecting every part of the nest, and winding round it in different directions to the very top, continually cross each other; many of these open into the dome in various places. All these minor galleries eventually merge in the large ones beneath the nest.

266. The white ants cannot ascend a perpendicular surface; yet these galleries in parts are quite perpendicular. The difficulty is overcome by the formation of a spiral pathway of easy ascent, and half an inch in width, which is constructed of clay, against the wall of the gallery, in the way of a geometrical staircase.

267. In order to convey the eggs from the royal chamber to the upper nurseries, several

elliptic bridges are formed, which save much labour and distance : these bridges are very slight and elegant, and are furnished on each side with a kind of parapet wall to prevent the labourers from falling over with their burdens. The width of these beautiful bridges is frequently less than half an inch.

268. The royal chamber contains, besides the king and queen, numerous labourers and soldiers : the labourers are incessantly engaged in feeding the royal pair, or carrying away the eggs laid by the queen ; the soldiers apparently act merely as a guard of honour, as there is never any demonstration of rebellion or ill-will on the part of the subjects.

269. If any accident happens to the building by the tread of some large animal, or the wilful aggression of the inquiring traveller, the soldiers instantly appear in the breach, at first two or three, then more, and if the attack continues they issue forth by hundreds, and even thousands ; being provided with immense jaws, they bite with exceeding sharpness, and never relinquish their hold.

270. When the aggressor has retreated, the soldiers retire within the building, and the labourers, who had during the attack kept closely within, hasten to repair the breach, each carrying in his mouth a mass of clay ready prepared for use, which on being placed instantly adheres, and

thus, by the united labour of millions, damages of great extent are repaired in a few hours.

271. If, during the operation of rebuilding, the aggressor again appears, and molests them, the labourers instantly retire, and the soldiers again sally forth, biting every thing they can reach with the utmost fury ; when all is quiet they again withdraw, and the labourers again appear : these scenes may be renewed constantly without the least diminution of the zeal and ferocity of the soldiers, or of the industry of the labourers.

272. Whilst the labourers are thus engaged, a few soldiers remain among them as sentinels, and also as overseers, to encourage and direct them. When the labourers appear to weary in the performance of their duty, these soldiers strike their jaws against the wall of the nest, producing a loud ticking noise, at which the labourers utter a loud hiss, and redouble their exertions.

273. Excepting in these repairs, when they are necessarily exposed, the whole of the operations of the white ants are carried on under cover. If a peculiar part of a tree is to be attacked, a covered way is made along the bark until it is attained.

274. The favourite food of the white ants appears to be wood, no kinds except teak and iron wood escaping them : they much prefer it when converted as timber to the living state. The provisions stored in the nests appear like particles

of wood gnawed off with their jaws, but when examined under a lens are found to consist principally of gum, or the inspissated juices of plants.

275. Their mode of proceeding is to consume the interior of whatever they attack, leaving the exterior quite perfect; thus fences, wainscots, bed-posts, &c. are often totally consumed, excepting an exterior surface not thicker than a wafer, which yields to the slightest pressure: houses and whole villages are thus frequently rendered uninhabitable.

276. When an upright post leading to rafters or a roof which is an object of attack, bears too great a weight to allow of this excavating, the parts consumed are supplied by the mortar of which the nest is fabricated, a small gallery for ascent only being left: this mortar becomes hard as stone, so that a wooden is often converted into a stone pillar.

277. The rapidity of their operations is so great that in two or three days a table may be completely consumed, if allowed to stand in the same place: they enter through the floor, excavate a leg, then the top, and descend by another leg; leaving the whole as perfect in appearance as before touched, though in reality a mere shell.

278. Portmanteaus, trunks, &c. are served in the same manner, the linen, papers, and every substance they contained, excepting metal and glass, being consumed; the frames of pictures and

looking-glasses, books, collections of insects, and other specimens of natural history, boots, shoes, coats, and hats, are equally acceptable.

279. Like the locust, the white ant is not to be resisted by man; wherever instinct directs its path, that path is implicitly followed; the hovel and the palace, rags and the purple robes of royalty, are alike liable to be its food: myriads may be destroyed, but myriads instantly supply the void.

CHAPTER XVI.

CONCLUDING OBSERVATIONS.

280. *Cantharides*, a drug of great value, and which, as the principal ingredient of blisters, is yet unequalled, is the name given to beetles collected in great abundance from ash and other trees in the south of Europe; they are merely dried and pounded, and are at once fit for use.

281. *Silk*, an article of dress, and one which gives employment, and consequent means of subsistence, to millions of human beings, is, as we have already related, the produce of the silkworm.

282. *Ink*, an article of immense importance in our communications with each other, and in the preservation of knowledge, is principally made from *galls* produced on trees by a minute insect called the gall fly.

283. *Cochineal*, the most valuable and beautiful of dyes, is an insect which feeds on a species of *cactus* in Mexico, and other parts of the continent of America.

284. *Kermes*, the most brilliant scarlet dye known previously to the discovery of America, is an insect found abundantly on the *quercus coccifera*, in the south of Europe : this was the celebrated Phœnician dye.

285. *Shell-lac*, a glutinous substance, now of very great importance in the manufacture of hats, and of value as an ingredient of printers' ink, is secreted by an insect which swarms on the trunks of several kinds of trees in India.

286. *Wax*, that enlightens our drawing-rooms, and in combination is applied to a great variety of purposes, is manufactured by the bee, whose history has already been related.

287. *Honey* is another production of the same industrious insect, and though much of its value has departed since the introduction of sugar, it is still an article of luxury.

288. *Mead*, a wholesome and delicious beverage, for which this country has long been famous, and the manufacture of which is still carried on with great skill and success in some of our counties, is made from honey.

289. *Locusts*, as an article of food, are spoken of in Scripture. The inhabitants of Fez, Morocco, and adjacent countries, eat them at this day ; and the Hottentots hail the coming of the locusts with delight, and are said to fatten on them.

290. The *fructification* of many plants is entirely accomplished by the different species of

bees, which convey the farina from plant to plant, and also from the stamens to the pointal of the same plant.

291. As *food* to birds and fishes, insects may be considered by far the principal article ; there is scarcely a bird or a fish but devours them with avidity.

292. The *turnip fly* has the power of destroying almost the whole crop of that excellent and useful vegetable, and as yet no certain cure is known for its ravages. Rusticus, an author before quoted, has ascertained that salting the seed acts in a good degree, as a preventive.

293. The *hop fly* has the power of destroying the produce of the hop in the most remarkable manner : the crop appears exclusively dependent on the scarcity or abundance of this insect.

294. The *locust*, by pestilence or famine, has had, in all ages, the power of sweeping millions of human beings from the face of the earth.

295. The *mosquito*, by its unceasing attacks, is capable of rendering life an almost insupportable burden : gnats, and other flies, in hot countries, have an influence over us scarcely less fearful.

296. *Economy* of space and materials in architecture is taught us by the bee ; the construction of the honeycomb in hexagonal cells, with triangular bottoms, accomplishes these objects in perfection : geometricians can discover no possible improvement on the plan which bees adopt.

297. The *strength of an arch* is taught us by the white ant, whose plastered domes are so strong that men may safely stand on them, and it has been said that wild bulls fight on them.

298. *Mortar* is made by several kinds of bees, and of the best possible composition ; that which hardens almost instantly on exposure, and is not liable to be moistened again by wet.

299. *Nocturnal lights* are recommended to us by the use made of them by the various fire-flies which illuminate the trees in tropical countries all night long with their sparkling lamps.

300. These facts, combined with the foregoing histories, tend to show that insects perform no very inconsiderable part in creation ; and that, whether as instruments of convenience and utility, sources of injury and annoyance, or examples of industry and economy, they cannot reasonably be despised.



THE
GRAMMAR
OF
ENTOMOLOGY.

BOOK II.
PHYSIOLOGY OF INSECTS.

To trace in Nature's most minute design
The signature and stamp of power divine ;
Contrivance intricate expressed with ease,
Where unassisted sight no beauty sees ;
The shapely limb, the lubricated joint,
Within the small dimensions of a point,
Muscle and nerve miraculously spun,—
Hrs mighty work, who speaks, and it is done.

BOOK II.

PHYSIOLOGY OF INSECTS.

CHAPTER I.

PHYSIOLOGY OF INSECTS IN GENERAL.

301. THE Physiology of Insects is the account of how they are made : there are in every animal four essential elements,—*matter, motion, sensation, and mind.*

302. Matter is inert—it does not move by its own powers ; it is tangible—the touch ascertains that it resists : matter in animals has various degrees of consistency ; convenience, however, has suggested its division into solid and fluid.

303. Matter, chiefly in its solid form, is the element of which the systems of organs are composed ; and organs are the instruments by which functions are performed : in all animals there are seven systems of organs to perform seven series of functions.

304. The seven systems of organs and their respective functions are these :—*bones*, for *support* ; *muscles*, for *motion* ; *air-tubes*, for *respiration* ; *blood-vessels*, for *circulation* ; *alimentary canal*, for *digestion* ; *nerves*, for *sensation* ; and the organs of the *sexes*, for *reproduction*.

305. The fluids in insects are blood and various secretions : the blood is supplied by nutriment transmitted from the alimentary canal : the solid parts are renewed by secretions from the blood.

306. Motion, in the animal frame, is of two kinds ; *dominant motion*, which acknowledges not the authority of the mind ; for instance, circulation of the blood ; and *subservient motion*, which operates only in accordance with the behests of mind.

307. Sensation is the ultimate power of matter so perfected as to take cognizance of facts beyond the limits of the body : sensation is of two kinds ; that derived from external objects, which appears the aim of animal life, and conduces to its maintenance, and that which conveys information from matter to mind, and behest from mind to matter.

308. Mind is the commanding element ; the other elements in acting obey it, but in existence and characters are independent of it : no powers of mind can prevent the existence, or change the characters of matter, motion, or sensation : mind

argues, then commands; it takes cognizance of causes, and provides for consequent effects, before the other elements can obey its behests.

309. The great powers of mind are speculation and retention: speculation is the power which supposes an event that has not yet occurred; and retention is the power of preserving an image left on the mind by an event that has occurred.

310. Of the connexion of mind with the organs which it commands we know nothing; mind itself is only known by its effects: its commands are carried by the nerves; a fact ascertained by separating a nerve; after which separation, the mind no longer controls the parts to which that nerve extended its branches.

311. The physiology of insects is, however, properly confined to the description of their systems of organs, and to the functions which these organs perform: therefore, excepting as connected with the organs, no farther notice will be taken of any other element than matter.

312. It must be observed that parts performing obvious offices, are commonly called the organs of those offices; thus *legs* are termed *organs of locomotion*, and *jaws*, *organs of manducation*: these terms are not in themselves improper, but lead, in some degree, to a vagueness of phraseology.

313. In the following chapters of this book,

the term *organs* will therefore be strictly confined to the grand systems of organs ; and the wings, legs, mouth, &c. treated of simply as such.

CHAPTER II.

OF THE ORGANS OF SUPPORT IN GENERAL.

314. INSECTS, instead of having internally a frame-work of bones supporting the softer parts, in which are included all the other systems of organs, have their external skin or covering indurated, incrassated, ossified, and invested with the same power as the frame-work of bones in ourselves possesses, of supporting the softer parts, and affording points of attachment for the muscles.

315. This indurated and incrassated skin completely envelopes the animal in the manner of a suit of armour, inclosing the softer parts, and protecting them from injury: in its composition it possesses most of the elements found in the bones of vertebrated animals, but not in the same proportions.

316. To admit of perfect freedom of motion in the performance of those numerous acts in

which an insect's life is passed, and many of which we have recorded in the preceding Book, it is essential that this bony covering should be in some way jointed, otherwise constant difficulty must occur.

317. The body, therefore, which is very long in proportion to its breadth, is divided into thirteen rings or segments (*segmenta*), the interstices between these being filled by a softer and more flexible portion of the same skin, which, in its indurated state, forms the segments.

318. This alternation of flexible and inflexible portions of skin, allows not merely a free motion to the right or left, upwards or downwards, but of great increase or decrease of length at the pleasure of the insect.

319. Contraction is readily performed by the rings being drawn one within another ; and elongation, by extending and separating the rings : their action is in some degree represented by the sliding of the tubes of a telescope. The body of the common wasp will illustrate this contracting and elongating power.

320. With the exception of the first, which is the head in all insects, the segments have no English names ; the Latin ones are, therefore, universally used ; and this is preferable to burthening the mind with two names for the same part.

321. The first segment is the head (*caput*) ; it consists of a skull, in which are situated two

antennæ or feelers, two eyes, and a mouth: the head is very distinct from the following segments, and is generally so articulated to the second segment, as to possess freedom of motion in every direction.

322. The second segment (*prothorax*) is the one which is so very large and convex in the common chafer, and which appears to receive the head into an excavation or cup: in a locust, or a cricket, it is equally large; but in a butterfly, fly, or bee, it is exceeding narrow, and scarcely perceptible.

323. The prothorax bears a pair of legs, which are called fore legs (*propedes*); these legs are so articulated to the prothorax, as to allow perfect freedom to their movements.

324. The third segment (*mesothorax*) is the large convex part so prominent in butterflies, bees, and flies; it is a narrow segment in beetles, crickets, &c: it is so articulated with the prothorax, as to allow that segment less freedom of motion than is possessed by the head.

325. The mesothorax bears two wings, one of which is attached to each side of it; these are called fore wings (*proalæ*): and two legs attached to its inferior surface; these are called middle legs (*mesopedes*); they possess equal freedom with those of the prothorax.

326. The fourth segment (*metathorax*) is small in butterflies, flies, and bees, but large in beetles,

crickets, &c. : it is seldom, in any instance, so conspicuous, prominent, and convex, as the prothorax and mesothorax are in many insects.

327. The metathorax bears two wings, one of which is attached to each side ; these are called the hind wings (*metalaæ*) ; and two legs attached to its inferior surface ; these are called the hind legs (*metapedes*).

328. The order of these four segments, and the names and positions of the limbs which they bear ; the two antennæ, two eyes, a mouth, four wings, and six legs ; ought to be well impressed on the memory : the possession of these limbs or appendages at once identifies a living animal as being an insect.

329. The possession of a greater or less number of antennæ, eyes, mouths, wings, or legs, leads us to refer an animal to some other division. It may not be amiss here to remark, that Insects form a portion of a larger group of animals ; and that the external skeleton is a character common to them all.

330. The fifth segment (*propodeon*) is generally of less size than the three preceding segments ; it is usually so closely united to the metathorax, as to be distinguished from it only by a sutural line. The propodeon and following segments never bear limbs of any kind, whether wings or legs.

331. The peduncle, or sixth segment (*podcon*),

is almost invariably smaller than either of the preceding: in many tribes it is so exceedingly slender and thread-like, that the insect is divided into two large incrassated masses.

332. From this appearance, the terms *entomos*, *insectum*, *insecte*, *insect*, &c. have arisen: the ichneumon, the common wasp, the honey-bee, the butterfly, the house-fly, are all familiar illustrations of this, and may be termed pedunculated insects: in these instances, the podeon is so articulated as to possess great freedom of motion; but in beetles, locusts, &c., in which it is not materially less than the propodeon it possesses but little power of motion.

333. The seventh segment (*metapodeon*) in the pedunculated insects, is very small at its union with the podeon, but very large at its union with the eighth segment: in other insects it is of uniform size.

334. The eighth segment (*octoon*) in the pedunculated insects, is the largest segment, with the exception of the mesothorax; in some of the wasps and the smaller ichneumons, it is larger than the whole of the five following segments, which are not unfrequently concealed within it.

335. The ninth segment (*ennaton*), tenth segment (*decaton*), and eleventh segment (*protelum*), are still smaller; uniformly decreasing in size, and often retractile each within the one preceding it.

336. The twelfth segment (*paratelum*) is still

smaller ; in the females of all bees, wasps, and insects of the same form, it is the last segment, the telum not being present in its usual form.

337. The thirteenth, or last segment (*telum*), is usually the smallest of them all ; it is often conical, terminating in a point : in the females of bees and wasps it is wanting ; its place is, however, supplied by a sting, into which it is converted. No male insects have a sting.

338. Each of these thirteen segments have a superior surface, or back (*scutum*) ; an inferior surface, or breast (*sternum*) ; and two lateral surfaces or sides (*pleura*) : the scutum and sternum are generally much more prominent parts than the pleura.

339. The scutum of each segment is occasionally transversely divided by sutural lines or indentations, into four smaller portions, called its first, second, third, and fourth sections (*præscutum*, *scutum*, *scutellum*, *post-scutellum*) ; of these, the præscutum is the section nearest the head ; the others follow in succession. These sections are readily to be distinguished in the prothorax of a locust, and some other instances ; but frequently all trace of division is lost, as in the prothorax of a beetle, or the octoon of a wasp.

340. The sternum is occasionally divided by sutural lines or indentations, into four smaller portions, called its first, second, third, and fourth sections (*præsternum*, *sternum*, *sternellum*, *post-*

sternellum); these divisions are but rarely distinguishable.

341. The pleura are also divided by sutural lines or indentations into four smaller portions, called their first, second, third, and fourth sections (*præpleura*, *pleura*, *pleurella*, *post-pleurella*); these divisions are rarely distinguishable on more than one segment of an insect.

342. The wings and legs being invariably inserted in the pleura or sternum of the segments, generally force out of their places the portions in the neighbourhood of their origin, so that care is required in deciding on and applying the names to each.

343. The upper, or scutal portion of each segment, has no such interruption to simple development; this portion, therefore, is employed in description in preference to the others.

344. When the scutum of either segment is apparently undivided, it is called simply *scutum*; when, as in the mesothorax of the hornet, *one* obvious line crosses it, the anterior portion is the *scutum*, the posterior, the *scutellum*; when, as in the bluebottle-fly, *two* obvious lines cross the mesothorax, the first section is the *præscutum*, the second, the *scutum*, and the third, the *scutellum*.

345. The propodeon in the hornet, and a vast number of other insects which resemble it in structure, has a longitudinal line or indentation

down its centre, but is not, in any instance, divided transversely.

346. An infinite number of descriptions refer to the parts now under consideration ; and it is, therefore, essential that we thoroughly understand them : let us take a hornet in hand, and examine them.

347. A hornet is nearly nipped in two in the middle by the smallness of the podeon ; the part below is now generally termed the *body*, formerly, the abdomen ; both names are used in descriptions : the part above the podeon, between that segment and the head, is often called the *thorax* ; its parts are these :—

348. Adjoining the head is the scutum of the prothorax (*prothoracis scutum*) ; this is, centrally, a very narrow piece, but extends and widens on each side nearly to the base of the fore wings.

349. Adjoining this is a large triangular piece, the apex of the triangle almost touching the head of the insect, and its base being below the insertion of the fore wings, and extending across the insect from side to side : this is the scutum of the mesothorax (*mesothoracis scutum*).

350. At the base of each fore wing, between it and each lateral angle of the scutum of the mesothorax, is a small raised lump : these are called little scales (*squamulæ*).

351. Immediately following the scutum of the

mesothorax, is a narrow section, extending across the insect from side to side between the hind wings: this is the scutellum of the mesothorax (*mesothoracis scutellum*).

352. The next section is of similar shape, but still narrower; this also extends from side to side across the insect, and is the scutum of the metathorax (*metathoracis scutum*).

353. Now follows a large square section, into the lower part of which is inserted the podeon, or peduncle; this is the scutum of the propodeon (*propodeonis scutum*).

354. The sections developed are five in number, being only one more than the number of segments: it may be also observed, that the three anterior sections are in a horizontal position, the two posterior are in a vertical position.

355. In beetles, butterflies, and many other insects, these parts are not employed or mentioned in descriptions; but in all insects with transparent wings, they afford excellent characters for distinguishing divisions.

356. The telum, or last segment, frequently bears appendages, the use of which appears doubtful; in some insects these are like bristles; in others, like forceps; in others, like leaves, &c.

CHAPTER III.

OF THE ORGANS OF SUPPORT IN THE HEAD.

357. THE head of insects, like the following segments, is composed of four smaller portions ; in this instance, however, not merely distinguished by sutural lines, but perfectly separated, and freely articulated : these are the skull (*cranium*), the upper and lower lips (*labrum, labium*), the feeler-jaws (*maxillæ*), and the jaws or mandibles (*mandibulæ*) : the lips, feeler-jaws, and jaws, constitute the mouth of an insect.

358. Each section of the head has a tendency to produce two feelers : on the last, the mandibles, they are obsolete ; on the skull, lips, and feeler-jaws, they are very distinct : in the lobster, and other animals resembling it, which are closely related to insects, the mandibles are furnished with distinct feelers.

359. The skull consists of four portions ; the superior surface or crown (*epicranium*), the inferior

surface or throat (*gula*), and the lateral surface or eyes (*oculi*).

360. The epicranium is frequently divided by a sutural line, passing across the forehead from eye to eye. When this is the case, the portion so separated, and which immediately covers the mouth, is called the shield (*clypeus*): the *gula* is often separated by a similar sutural line; in this case, the anterior portion adjoining the mouth is called the chin (*mentum*).

361. There are one, two, or three minute, transparent, highly convex lenses, situated on the crown of the head, into which they are closely soldered; these are called simple eyes (*ocelli*): all insects, except beetles, seem to possess them more or less perfectly.

362. The cranial feelers (*antennæ*) arise from the skull in front of the ocelli, between the eyes, and above the clypeus; they are freely articulated with the skull, and moveable in every direction: they are composed of numerous joints.

363. In length, stoutness, shape, and clothing, the antennæ of insects are very various; their variations are the subject of nomenclature; and, moreover, afford excellent characters for descriptions.

364. Setaceous antennæ (*antennæ attenuantes*) are those which are long, throughout slender, and yet taper gradually to the apex; the union

of the joints takes place without any marked indentation or protuberance.

365. Filiform antennæ (*antennæ filiformes*) are usually stouter and shorter, and preserve throughout a uniform substance.

366. Incrassated antennæ (*antennæ accrescentes*) resemble the last, excepting that they gradually increase in substance towards the apex.

367. Fusiform antennæ (*antennæ fusiformes*) are stoutest at the middle, and taper very gradually to each end.

368. Moniliform antennæ (*antennæ moniliformes*) differ from the filiform in one character only : each separate joint is oval or globose, and the portion connecting it with the next is very slender ; the joints thus resembling beads on a string.

369. Serrated antennæ (*antennæ serratæ*) have each joint produced on one side at the apex, so that together they resemble the teeth of a saw.

370. Pectinate antennæ (*antennæ pectiniformes*) are those in which the joints are still more produced, or rather, are furnished on one side with slender processes, resembling, in some degree, the teeth of a comb.

371. Flabellate antennæ (*antennæ flabelliformes*) have the processes of the joints still longer, very thin, and, when at rest, lying flat on each other, like the folds of a fan : the antennæ

of some insects are flabellate throughout, others have only the apical portion flabellate.

372. Ciliate antennæ (*antennæ fimbriatæ*) are those which, in primitive structure, are setaceous; but each joint is furnished on each side with a single hair.

373. Elbowed, kneed, or broken antennæ (*antennæ fractæ*), are those which have one joint, usually the second from the base, very long, and the remaining joints attached to it at a right angle.

374. Pilose antennæ (*antennæ pilosæ*) are not of any peculiar structure, but are covered entirely with a soft down.

375. Setose antennæ (*antennæ setosæ*) are not of any peculiar structure, but are furnished throughout with irregular harsh bristly hair.

376. Plumose antennæ (*antennæ plumosæ*) are, in primitive form, setaceous, but are furnished with long downy hairs, which give them the appearance of a feather.

377. Ramose antennæ (*antennæ ramosæ*) are generally of setaceous or moniliform structure, but differ in having several joints near the base, produced into long branches, sometimes nearly equalling the antenna itself in length.

378. Bifurcate antennæ (*antennæ bifurcæ*) are generally composed of three joints, of which the apical one is very long, bent double, and attached at its centre to the second joint.

379. Clavate antennæ (*antennæ clavigeræ*), are terminated in a gradual club, the shaft being generally long, slender, and filiform.

380. Capitate antennæ (*antennæ capitatæ*) are those in which the knob is more abrupt, and strongly marked: the knob is sometimes solid, consisting of a single joint, sometimes composed of many joints.

381. Perfoliate antennæ (*antennæ perforatæ*) are those in which a portion of each joint is dilated and flattened; and the remaining portion being cylindrical and slender, appears like a thread, on which the dilated portions are strung.

382. Setigerous antennæ (*antennæ setigeræ*), are those in which the basal joints are stout and short, the third being much the largest, of various shapes, and having the remaining joints, which are formed into a kind of bristle, attached on one side of it, often at a right angle.

383. Antennæ are of various kinds, besides those here described; but all the common forms may be found in the foregoing list: when other forms occur, their peculiarities are described: no general name is applied to them.

384. The length as well as the structure of antennæ is very various; sometimes they are so short as to be concealed from the sight in the little cavities in which they stand; sometimes they are five times the length of the body.

385. The eyes of an insect commonly form the

lateral portions of its head; they are two in number, and are composed of numerous highly convex lenses; these lenses are hexagonal; and yet not fitting closely to each other, but each situated in a square. The number of lenses varies from fifty to twenty thousand in a single eye.

386. Every one of these lenses receives the image of an object, and appears very nearly to correspond in properties with the crystalline lens of the human eye; so that a butterfly may, without exaggeration, be said to possess forty thousand eyes.

387. Many insects have each of the eyes divided horizontally by an elevated line; thus giving them the appearance of being double: in such instances the insect appears to have four eyes.

388. Petiolated eyes are those which are placed at the end of distant stalks, which are situated one on each side of the head: this is a very rare and remarkable character in the eyes of insects: it occurs in a peculiar kind of flies.

389. The form of eyes is very various; the variations are expressed by the usual descriptive terms of shape, as round, heart-shaped, oblong, kidney-shaped, &c.

390. The mouth of an insect is situated below the head, and generally projects slightly forwards; this being by far the most convenient position for

taking food. It consists of an upper and lower lip, two mandibles, two feeler-jaws, and a tongue.

391. The upper lip (*labrum*) corresponds closely with the same organ in vertebrate animals : it is a solid, horny plate, which arises from beneath the clypeus, and projects beyond it : it is articulated at its junction, with the head moving freely in a vertical direction, and closing the mouth above : its appearance is more uniform than that of any other organ of the mouth.

392. The uvula (*hypopharynx*) is a valve attached to the interior surface of the upper lip ; its office is to close the throat. The hypopharynx is not to be discovered in the generality of insects ; it is, however, particularly prominent in some kinds of wild bees.

393. The throat (*pharynx*) is the opening immediately below the hypopharynx ; it is the only passage for the food into the stomach.

394. The lower lip (*labium*) closes the mouth below, as the upper lip does above : it is a much more complicated organ than the upper lip, and its variations afford excellent characters for descriptions : it consists of four distinct parts, which are obviously separated by sutural lines.

395. The insertion of the lower lip (*insertio*) is usually concealed by the mentum below it, but occasionally projects considerably beyond it, and becomes a part of some importance.

396. The true lip (*labium proprium*) is a solid,

horny plate, corresponding in character with the upper lip: its variations in form are of great assistance to entomologists, in determining to which kind any insect belongs.

397. The third portion of the lip (*palpiger*) appears mostly to rise from behind the second part, but not unfrequently is continuous with it, and separated only by a sutural line; it is usually smaller, and of softer substance than the second part, and it invariably is to be distinguished by bearing the feelers.

398. The labial feelers (*labipalpi*) originate one on each side of the *palpiger*, from which they continue divaricating: these are composed of several distinct joints, of which the terminal one varies much in form.

399. The terminal portion of the lip (*ligula*) is always more soft and fleshy than either of the preceding parts: it is remarkable for the infinite variety of forms which it assumes, and is the most certain guide in ascertaining insects from description.

400. An entire *ligula* (*ligula integra*) is when its termination is simple and undivided; an entire *ligula* is either *obtuse* or *acute*, *truncate* or *rotundate*, *elongate* or *abbreviated*.

401. A bifid *ligula* (*ligula bifida*) is when there is a deep notch down its centre, thus making the termination double: a bifid *ligula* is usually very obtuse.

402. A trifid ligula (*ligula trifida*) is when it has three distinct terminations; this ligula is more variable in form than the foregoing: the three terminations are sometimes obtuse lobes, sometimes long setiform processes.

403. A quadrifid ligula (*ligula quadrifida*) is when it has four distinct terminations; this ligula has usually the appearance of having really but three lobes, with the central lobe deeply cleft.

404. A setiform ligula (*ligula setiformis*) is when the central lobe of a trifid ligula is very long, slender, and pliable; the lateral lobes being very small, or merely rudimental: these small lateral lobes have been called *paraglossæ*.

405. A palpiform ligula (*ligula palpiformis*) is bilobed or quadrilobed; and the two or four lobes, as the case may be, are jointed in the same manner as the feelers.

406. The tongue (*lingua*) is usually attached to the inner surface of the lower lip, very near its base. In the locust the tongue is very prominent and remarkable, assuming nearly the form of the human tongue: in some bees it is distinguishable, but not prominent: in most insects it is difficult to be found: the tongue has also been called *epipharynx*.

407. The feeler-jaws (*maxillæ*) are situated immediately above the lower lip. They have great variety of form and motion; they are at once to be distinguished from the mandibles by

the possession of feelers; they are divided by sutural lines into four parts,—the insertion, the disk or stalk, the feeler-bearer, and the blade. They also bear the helmet and maxillary feelers.

408. The insertion (*insertio*) is mostly hidden by the neighbouring portions of the skull when the maxilla is at rest; but, on the least motion, a portion of it becomes visible on each side of the lower lip; it is of softer and more cartilaginous substance than the part which succeeds it.

409. The disk or stalk of the feeler-jaw (*maxilla*), is divided from the insertion by a sutural line; it is hard, glabrous, and of various formations.

410. The feeler-bearer (*palpifer*) is usually placed above the stalk of the feeler-jaw, but is often parallel with it, thus constituting its exterior portion; in either case it is a solid corneous part, and distinctly divided from the stalk by a sutural line. It may be useful to observe, that a knowledge of these parts is not essential to accurate generic description, their variation being less available than those of the succeeding portions of the feeler-jaw.

411. The blade of the feeler-jaw (*lacinia*) is its apical portion, and its variations are of great importance, for on them the great divisions of insects are principally founded.

412. A convolute blade of the feeler-jaw (*lacinia convoluta*) is when it is rolled up below

the head in the manner of the main-spring of a watch, or the Ionic volute in architecture. When bearing this form it is exceedingly long, slender, and pliable; and the blades of each feeler-jaw being internally grooved, unite and form a honey-sucking tube: it has this form in butterflies.

413. A lanceolate blade (*lacinia lanceolata*) is when it is straight, flat, decreasing gradually to a sharp point, incapable of any horizontal motion, and employed by being thrust vertically into the object on which its possessor feeds: it has this form in blood-sucking gnats and flies.

414. A leathery blade (*lacinia coriaria*) is when it is composed of a tough, strong, and flexible substance; when this is the case, it usually is very long, without horizontal motion, parallel with the ligula, and unites with that part of the mouth in forming a sucking-tube: it has this form in bees.

415. An obtuse blade (*lacinia obtusa*) is when it is not produced into a conspicuous or active form, but terminates the feeler-jaw in a rounded and apparently undeveloped form.

416. A falcate blade (*lacinia falcata*) is when its point is acute, and bent over towards the opposite blade: this kind of blade has its interior edge, *hirsute*, *dentate*, or *simple*; its point, *bifid* or *simple*.

417. An articulated blade (*lacinia articulata*) is when it unites with the disk of the feeler-jaw

by means of a distinct and free joint instead of a sutural fixed line: it has this form in the tiger-beetles.

418. The helmet (*galea*) is situated on the back of the feeler-jaw, behind the blade, and before the feeler; its variations are very numerous, and, consequently, very useful in assigning characters to insects.

419. A palpiform helmet (*galea palpiformis*) is when it is perfectly distinct from the blade, and composed of one, two, three, or four cylindrical joints, like those of the feelers or antennæ: it has this form in carnivorous beetles.

420. An obtuse helmet (*galea obtusa*) is when it appears simply as a shapeless mass; it assumes this form frequently when the lacinia is also obtuse, and much resembles it in appearance.

421. An obsolete helmet (*galea obsoleta*) is when it is closely united to the blade: sometimes a mere sutural line, and occasionally not even that, denotes any separation between them.

422. The maxillary feeler (*maxipalpus*) rises from the feeler-bearer immediately behind the helmet; its principal variations are in the number, form, and proportion of its joints: the description of these are very simple, and easily understood, without the employment of any set terms.

423. The mandibles (*mandibulæ*) are situated

immediately below the upper lip, and immediately above the feeler-jaws, one on each side of the mouth, meeting, and sometimes crossing in front : when possessed of motion, they move horizontally.

424. Rudimental mandibles (*mandibulæ incipientes*) are those which are perfectly without motion, and, apparently, without use ; they are small scale-like processes adhering to the skull, and are utterly incapable of gnawing solid substances : they have this form in butterflies.

425. Linear mandibles (*mandibulæ lineares*) are those which are of uniform size and substance ; which are perfectly straight, parallel, and approximate ; they are always without the horizontal motion, and utterly incapable of gnawing solid substances : they have this form in many flies.

426. Tubulate mandibles (*mandibulæ tubulatæ*) are those which are hollow, and perforated at the extremity to admit the passage of the blood of other insects, on which the insects possessing such mandibles always feed : the mandibles possess this form in the larvæ of some carnivorous beetles, and in that of the ant-lion.

427. Falciform mandibles (*mandibulæ falciformes*) are when they are long and much curved, in the shape of a sickle ; they move horizontally with great ease, are hard and acute, and, when closed, cross each other : insects possessing these

mandibles bite severely, and prey on other insects.

428. Bifid mandibles (*mandibulæ bifidæ*) are when the extremity is terminated by two distinct points of equal length and similar appearance, otherwise one of them would be called a tooth.

429. Toothed mandibles (*mandibulæ dentatæ*) are when the internal mandibles are beset with teeth: when this is the case, they are hard and bony, have a rapid and powerful horizontal motion, and are capable of gnawing very hard substances.

430. Setiform mandibles (*mandibulæ setiformes*) are when they are very slender, flexible, thread-like, without horizontal motion, and often completely enclosed in a sheath; which sheath is the lower lip.

431. To understand the structure of the head of an insect, it is essential to examine it,—to handle it,—to dissect it,—then the foregoing description will probably prove useful; but no description, without ocular demonstration, can be made perfectly clear.

432. The structure of an insect's mouth will be pretty well understood by a comparison with our own, if we suppose it possible for our upper and lower jaw each to be divided down the middle, and the two halves of each to move from side to side, meeting in front, the lips and tongue remaining as they are.

433. Our upper lip corresponds, then, precisely to the labrum of insects; our lower lip, to the labium; our upper jaw, divided, to the mandibles; our lower jaw, divided, to the maxillæ; our tongue, to the tongue; and, when both mouths are closely shut, the parts in each occupy similar places. A locust's mouth aptly illustrates this.

CHAPTER IV.

OF THE WINGS AND LEGS OF INSECTS.

434. THE wings and legs of insects are situated in equal numbers on each side of a right line drawn down the back; they constitute five pairs, four wings and six legs.

435. The fore wings (*proalæ*) arise from the sides of the mesothorax; they vary in composition, covering, and form, and their variations afford excellent distinguishing characters.

436. Scaly fore wings (*proalæ squamosæ*) are membranaceous, and covered with a coat of minute scales placed in rows; the edges of the scales in one row, covering the insertions of those in the next, like the scales of a fish, or the tiles of a house: these wings are used principally in flight. The wings have this character in the butterfly.

437. Membranaceous fore wings (*proalæ membranacæ*) are composed of a delicate transparent

membrane, which is upheld and moved by various strong nervures, traversing it in various directions : in the fly, these fore wings alone perform the office of flight ; in the bee, they have the assistance of a second similar pair : a portion at the base of membranaceous wings is called the winglet (*alula*).

438. Crustaceous fore wings (*proalæ crustaceæ*) are composed of a hard, brittle substance, incapable of being bent or folded without injury ; incapable also of being used in flight, and serving only as a protecting cover to the more delicate hind wings : the fore wings possess this character in all beetles ; and in descriptions are usually called wing-cases (*elytra*).

439. Leathery fore wings (*proalæ coriaceæ*) are composed of a tough, leathery substance, which will bend readily without breaking, but which never folds naturally ; such wings are seldom of much service in flight, yet are occasionally used for that purpose : they have this character in the locust.

440. Half-leathery fore wings (*proalæ semi-coriaceæ*) are when they have the basal portion of the leathery substance, described in the last paragraph, and the apical portion, membranaceous and transparent : plant-bugs have this kind of fore wings.

441. Reticulated fore wings (*proalæ reticulata*) are covered by an infinity of nervures

crossing each other in every direction; these nervures give the wings the appearance of beautiful net-work: dragon-flies have wings of this character.

442. The hind wings (*metalæ*) possess the characters of being scaly, membranaceous, or reticulated, the same as the fore wings; but they are never crustaceous, leathery, or half-leathery.

443. The hind wings rise from the sides of the metathorax, one behind each of the fore-wings; they occasionally possess characters which the fore wings have not.

444. Petiolated hind wings (*metalæ petiolatæ*) are when they have ceased to bear the appearance of wings, and have become mere knobs, placed at the extremity of a short foot-stalk: in this form they are usually termed *poisers* (*halteres*), and are possessed by all flies and gnats.

445. Setaceous hind wings (*metalæ setiformes*) are when they have ceased to bear the appearance of wings, and have become simple bristles, totally useless in flight.

446. The nervures in membraneous wings divide the membranes into small compartments, called cells (*cellulæ*); these cells are very constant in their form and proportion in the same kinds of insects; consequently their variations distinguish one kind from another.

447. The strong nervure which runs along the upper edge of each wing, either on the extreme

edge or just below it, is called the costal nervure (*nervura costalis*); and the portion of membrane, if any, above this nervure, is the costal cell, or if divided by minor nervures, the costal cells (*cellulæ costales*).

448. The incrassated portion of this nervure, which is frequently observable at about two-thirds of the distance from the body, towards the apex of the wing, is called the stigma (*stigma*).

449. The cells immediately beyond the stigma, towards the extreme point of the wing, are called the marginal cells (*cellulæ marginales*); these are generally two or three in number; and the cells immediately below these, the submarginal cells (*cellulæ submarginales*).

450. The wings of all insects present a somewhat triangular figure. The upper portion of this triangle is called the costal region (*regio costalis*); the outer portion, the exterior region (*regio exterior*); the lower portion, the inferior region (*regio inferior*); and the central portion, the central region or disk (*discus*). Attention to this will render most descriptions of the numerous cells and nervures intelligible.

451. The legs of insects do not undergo the same degree of variation as the wings; they are of a more uniform structure, not only as regards different kinds of insects, but as regards the legs of the same insects: they are six in number, or three pairs, the fore legs (*propedes*), which are the

pair nearest to the head ; middle legs (*mesopedes*) ; and hind legs (*metapedes*).

452. The natural position of the legs in most insects, when perfectly at rest, is for the fore and middle legs to point forwards, the hind legs backwards : some beetles form an exception to this, the fore legs alone pointing forwards.

453. The legs are so nearly of uniform structure, that the description of one serves for the six : trifling variations, where they occur, being easily pointed out in descriptions. The legs of an insect consist of four parts, called the hip, thigh, shank, and foot.

454. The hip (*coxa*) is a short and nearly globular joint : it either moves with perfect freedom in a socket, purposely excavated in the sternum of the insect, or is anchylosed in the socket, and a greater power of motion possessed by the next joint : in the first instance the coxa is called free (*coxa libera*), in the second, fixed (*coxa fixa*).

455. The thigh (*femur*) is a long and stout joint, moving with great freedom ; it is composed of three pieces, the separation of which is marked by strong sutural lines : these are called the first, second, and third joint of the femur (*femoris caput* ; *femoris trochanter* ; *femoris scapus*) : when two parts only are discernible, they are the second and third parts ; when only one, it is the third part, and is alone called the thigh (*femur*).

456. The shank (*tibia*) is a single piece, generally of about equal length with the femur, but occasionally differing greatly in this respect: it is usually three sided.

457. The tibia is called winged (*tibia alata*) when it is furnished with an attenuated dilated process, much resembling the extended membrane which constitutes the wing of a bat, but not so flexible.

458. The tibia is called corbiculate (*tibia corbiculata*) when it is furnished with a brush of stout hairs, for the purpose of brushing the fallen off flowers, and conveying it to its nest, as in bees.

459. The tibia, in almost all insects, is furnished with stiff spines or bristles, which are called spurs (*tibiæ calcaria*).

460. The foot (*tarsus*) consists of five joints, called the first, second, third, fourth, and fifth joints of the tarsus (*planta*, *metaplanta*, *allux*, *arthrium*, *ungula*); the first (*planta*) being nearest to the tibia, the others in regular succession.

461. In pedunculated insects the five joints of the tarsus are almost invariably present; in other insects one, two, or three of them are frequently missing: when an insect has four joints to the tarsus, the arthrium is wanting; when only three, the arthrium and pollux have disappeared.

462. The ungula is armed at its extremity with one, two, or four sharp curved claws (*unguiculi*): in the stag-beetle a sixth joint of the tarsus

(*plantula*) arises from between the claws, and this joint is furnished with two other claws.

463. The under surface of the joints of the tarsus are very frequently covered with soft cushions (*pulvilli*); these are composed of an almost infinite number of minute hairs, which, at their ends, are slightly dilated, and constantly exude an adhesive gummy matter.

464. By means of these gummy pulvilli, insects possessing them are enabled to walk freely on smooth surfaces, even with their backs downwards, against the power of gravity: other insects whose pulvilli exude a somewhat oily matter, run with ease and safety on the surface of water.

465. At the end of the ungula, between the claws, there is in the locust, and some other insects, a small soft ball called the little cushion (*pulvinulus*): this is a part of some importance for distinguishing characters.

466. There are attached to the telum, or last segment of the abdomen, many very singular appendages; the uses of some of these are known, of others unknown.

467. The appendages of which the uses are ascertained are these, the sting (*aculeus*), as in bees; the external ovipositor (*ovipositor exertus*), as in the ichneumon; the tubular retractile ovipositor (*tubulus*), as in the bot-fly; the saw (*terebella*), with which female insects bore a hole to deposit their eggs.

468. The appendages of which the uses are unknown or doubtful, are the leaflets (*foliolæ*); pincers (*forceps*), as in the earwig; tails (*caudæ* and *caudulæ*), as in the cockroach and cricket.

469. It may be proper to observe, that insects have many external parts here undescribed, and many yet unnamed; but sufficient are now noticed to enable a reader to describe any insect he may meet with, or to understand any description he may read.

CHAPTER V.

OF THE CHARACTERS OF SURFACE.

470. THE exterior or bony shell of insects, is very various in the character of its surface ; and as these variations are constant, or pretty much so, in the same kind of insect, a correct knowledge of the terms employed in distinguishing them is very essential.

471. The variations of surface are of two kinds : form of surface, called also *sculpture* ; and colour of surface. The terms employed to describe these are mostly from the Latin ; a language which affords great facility in defining slight distinctions.

472. The variations of form are many ; most of them are described by terms universally understood ; as convex, concave, flat, rough, smooth, shining, &c. ; others require elucidation.

473. Levigate (*levigatus*), is when the surface is perfectly free from elevations, or depressions of any kind.

474. Glabrate (*glaber*), is when it is brilliantly glossy.

475. Punctate (*punctatus*), is when the surface has the appearance of having been punctured thickly by the point of a pin; the pin not passing through, but simply making impressions.

476. Reticulate (*reticulatus*), is when the surface appears to be levigate, and yet to bear on it a covering of network.

477. Carinate (*carinatus*), is when there are strongly-marked longitudinal elevations, resembling the keel of a ship.

478. Canaliculate (*canaliculatus*), is when there are strongly-marked longitudinal impressions: the impression of a carinate surface would produce a canaliculate surface.

479. Sulcate (*sulcatus*), is when these longitudinal indentions are somewhat less deep than those to which the term canaliculate is applied.

480. Striate (*striatus*) varies from the foregoing, in the lines being still fainter.

481. Tuberculate (*tuberculatus*), and verrucate (*verrucatus*), are synonymous; they express the existence of small tubercles or warts.

482. Granulate (*granulatus*), is when the surface is completely covered with very much smaller tubercles, like shagreen.

483. Catenulate (*catenulatus*), is a striate surface, in which some of the elevated spaces between the striæ are interrupted, and broken into a series of short elevations.

484. We now proceed to the names of colours

employed by entomologists. All colours seem of two principal kinds, fictitious colours and real colours; the fictitious colours being black, brown, white, and their compounds; and the real colours, those displayed by the prism.

485. Blacks: piceous (*piceus*), the colour of pitch; atrous (*ater*), the colour of liquid ink; nigrous (*niger*), the colour of lamp-black; fuliginous (*fuliginosus*), the colour of soot.

486. Browns: olivaceous (*olivaceus*), the colour of olives; ferruginous (*ferrugineus*), the colour of rust; fuscous (*fuscus*), the colour of tanned leather; brunneous (*brunneus*), the colour of a chestnut; cinnamomeous (*cinnamomeus*), the colour of cinnamon; livid (*lividus*), the colour of liver.

487. Whites: griseous (*griseus*), the colour of grey hair; cinereous (*cinereus*), the colour of ashes; albous (*albus*), the colour of chalk; niveous (*niveus*), the colour of snow.

488. Reds: miniatous (*miniatus*), the colour of red lead; testaceous (*testaceus*), the colour of brick-dust; rufous (*rufus*), the colour of bright copper; coccineous (*coccineus*), the colour of the blossom of the horse-shoe geranium: sanguineous (*sanguineus*), the colour of blood; roseous (*roseus*), the colour of the rose.

489. Oranges: aurantious (*aurantius*), the colour of an orange; croceous (*croceus*), the colour of the crocus: fulvous (*fulvus*), the colour of the lion.

490. Yellows: sulphureous (*sulphureus*) the colour of brimstone; stramineous (*stramineus*), the colour of straw; luteous (*luteus*), the colour of the yolk of an egg; flavous (*flavus*), the colour of the sunflower.

491. Greens: glaucous (*glaucus*), the colour of the sea; prasinous (*prasinus*), the colour of the leaves of leeks; æruginous (*æruginosus*), the colour of verdigris; viridous (*viridis*), the colour of the leaf of the laurel.

492. Blues: ceruleous (*cæruleus*), the colour of the sky; cyaneous (*cyaneus*), the colour of the blue-bottle; azureous (*azureus*), the colour of the Adonis butterfly.

493. Violets: violaceous (*violaceus*), the colour of the violet; lilaceous (*lilaceus*), the colour of the lilac.

CHAPTER VI.

OF MUSCLES, THE ORGANS OF MOTION.

494. NEXT to the external solid parts, which ostensibly perform the active offices of insect life, must be considered those internal softer parts called muscles (*musculi*); the contraction and expansion of which cause the solid parts to perform those offices.

495. Muscle is a substance which yields to the touch: it consists of two parts; the body of the muscle, which is fleshy; and the extremities and coating of the muscle, which are tough, strong, and elastic, and are designated as *tendon*.

496. The surface of muscle is a beautiful microscopic object: it presents a series of exceedingly fine transverse lines, which, in contraction, assume an undulated form. The fibre of muscle is much the same in every animal, from man to the most minute animalcule.

497. The attachment of muscle is solely to the osseous plates or bones, which constitute the external covering of an insect; in these they

originate precisely in the same manner as the muscles in the human frame, are attached to, and originate in, the bones.

498. The bulk and form of muscles in insects are beautifully apportioned to the offices they are required to perform ; and unusual bulk in any part of an insect generally implies the presence of unusually developed muscle, and the object for which it is developed may be readily ascertained.

499. We have before seen, that the fore wings arise from the mesothorax, and the hind wings from the metathorax : these segments vary greatly in size, and this variation depends so precisely on the powers of flight possessed by each pair of wings, that an insect anatomist, on regarding these two segments alone, would at once decide on the relative power of the wing which they had borne.

500. In flies, the fore wings are alone used in flight ; the hind wings are rudimental ; the whole bulk of muscle, therefore, required for flight, is placed in the mesothorax : in beetles the hind wings are alone used in flight, and the bulk of muscle is consequently transferred to the metathorax.

501. It happens in some moths, that one sex flies and the other does not ; and in these the structure of the wing-bearing segments at once proves the provision of muscle in these is for the purpose of flight.

502. In the common ant the little worker never

leaves the ground ; wings, therefore, would be an incumbrance to it. We find that its pro- meso- and metathorax are very small and insignificant segments, while the mesothorax of the productive female is the largest segment in her body ; but it is one of her duties to perform a long flight, and to use the wings which that segment bears.

503. The muscles in those wing-bearing segments which do not employ their wings for flight, are probably not absent, but repose in a rudimental state ; while the muscles, whose active uses are required in the neighbouring segments, are increased at their expense.

504. The form of muscles in insects is as various as their size, and depends on the motion required of them : every muscle is precisely of the shape, as well as size, best adapted for the office it has to perform.

505. The muscles which serve to raise a leg and lift it forwards, and all similar simple movements, are linear or cylindrical when at rest, but in contraction become fusiform, the extremities attenuating, the centre incrassating, and the whole being abbreviated.

506. The muscles which serve to perform the wriggling undulating motion, so common in larvæ, especially those which are without legs, are triangular, and in motion contract alternately each side of the triangle, so that each angle becomes acute and obtuse in turn.

507. Muscles in insects more frequently cross and intersect each other than in vertebrated animals: in some instances, where connected with the organs of respiration and circulation, they are excessively minute, and appear actually interwoven, crossing in every direction, like multitudes of slender threads.

508. It is in such situation that dominant motion exists ; motion altogether independent of, and uninfluenced by, the will.

509. The principal muscles in insects are generally in pairs ; that is, each principal muscle has an antagonist muscle, which, after any given movement, has the power to restore the original position.

510. The muscles destined for the government of the limbs, are all of the linear or cylindrical form, and all in pairs, a flexor and extensor muscle being found in each joint of the legs, &c.

CHAPTER VII.

OF NERVES, THE ORGANS OF SENSATION.

511. IN vertebrated animals the brain is situated in the head. Brain is supposed to be the seat of mind : all the nerves originate in the brain : the nerves are the organs of sensation.

512. We find that in insects there is no part positively ascertained to be the brain : we discover nerves throughout the body, and we trace these to large masses or knots, situated at intervals the whole length of the insect.

513. Experience has shown us that, on the brain of vertebrated animals being separated from the body, or even greatly injured, both sensation and active vitality at once cease ; but in insects the separating of the head or of the parts containing either of these masses of nerves, produces no immediate or ascertainable effect on sensation or vitality.

514. This shows us, *first*, that mind or volition is, in vertebrated animals, situate in the brain ; *secondly*, that in insects it is not confined to an

exclusive part. These conclusions lead to the probability of a third, that brain and nerve are but different states of the same system of organs.

515. The vitality, therefore, concentrated in a brain, may be diffused through the nerves when there is no brain, and each mass of nerves may be the seat of that small power of mind which insects possess.

516. The nervous cord extending, as described, from one end of the insect to the other, is compared to, and has been called the, *spinal marrow*; its first knot, or incrassated portion, the *brain*; the following knots, *ganglions*: this nomenclature appears arbitrary, as we have seen that no particular portion exercises exclusively the functions of a brain.

517. It appears better to consider each of the little knots a separate and independent centre of volition, as it undoubtedly possesses the characters of such, giving out its various nerves in the same manner as the human brain.

518. All anatomical operations succeed best with the larvæ of insects, because the constant and obvious division of the body of larvæ into thirteen segments, afford us more ready means of describing the result of observation; whereas, in perfect insects, several segments are liable to become united, and the exact boundaries of each are thus rendered subjects of doubt.

519. It must also be observed, that the internal

systems of organs following and adapting themselves to the wonderful changes on the surface, require the utmost caution in the anatomist who attempts to characterise them.

520. Let us then examine the caterpillar of a common butterfly, and trace its system of brains and nerves: in this we have the advantage of being able to examine it in all stages, and to compare and ascertain, with tolerable certainty, both the mode and extent of change.

521. In the larva of a butterfly the spinal cord has thirteen knots, one in each of its segments; these knots, from their similarity in office to brain, may be called *cerebroids* (*cerebroidæ*); and each one may be distinguished by the name of the segment in which it is situated.

522. The first cerebroid (*capitis cerebroida*), is composed of two hemispheres; from these arise, in perfect insects, several pairs of nerves; there are two optic nerves (*nervi oculorum*); two antennary nerves (*nervi antennarum*); two mandibular nerves (*nervi mandibularum*); two maxillary nerves (*nervi maxillarum*); and two labial nerves (*nervi labii*).

523. To return, however, to the caterpillar, the first cerebroid is situated above the cavity of the mouth; from each hemisphere of the cerebroid a cord proceeds; these unite on leaving the head, just above the opening of the throat, forming the second cerebroid (*prothoracis cerebroida*); they

then again divide, and, passing one on each side of the gullet, reunite below it, and enclose it in a ring.

524. At the union they form the third cerebroid (*mesothoracis cerebroida*) ; and from this arise four principal nerves, two of which (*mesopedum nervi*) descend to the feet, and two others (*prothoracis nervi dorsales*) ascend to the back ; the cord then again separates, to re-unite in the mesothorax, where it again gives rise to four nerves.

525. After forming the fourth, fifth, and sixth cerebroids, separating in the same way between each, the cord proceeds single, and united to the propodeon, and through the other segments to the telum, leaving a distinct mass or cerebroid in each segment, which invariably gives out four nerves, two of which ascend to the back, and the other two descend, some entering the prehensile legs, with which most caterpillars are furnished.

526. In the telum is situated the thirteenth and last cerebroid (*teli cerebroida*), and this gives off no less than eight nerves, most of them permeating the organs of generation : thus the number of main nerves arising from the whole of the cerebroids in this caterpillar, is sixty-two.

527. The twelfth and thirteenth cerebroids are attached and sessile without any intervening cord ; the spaces between the others vary very rapidly as the insect approaches perfection.

528. In the first place, the second cerebroid enters the head, and becomes united with the first ;

then the fifth and sixth approach and unite ; then the third and fourth ; lastly, in the pupa, the seventh and eighth wholly disappear, and eight only are to be found in the perfect butterfly.

529. The nerves, after leaving the cerebroids, divide, and ramify almost infinitely, being more particularly abundant in the head and tarsi of the legs ; they do not appear to penetrate the ossified skin, although they are found close beneath it.

530. The nerves are the means by which the circumstances of matter are conveyed to the mind ; and also the means by which the commands of mind are conveyed to matter : in the former capacity they are the organs of the senses.

531. The senses of insects are, properly speaking, seven : love, touch, taste, smell, hearing, sight, and the commanding and governing sense, called volition, mind, thought, or instinct.

532. Love is that sense which ensures obedience to the great command, Increase and multiply ; its gratification seems the main object of an insect's life, after having arrived at maturity : its seat is in the organs of generation.

533. Touch is a most invaluable sense to insects ; they have two antennæ and four feelers attached to the mouth, which appear provided purposely for the exercise of this sense : the tarsi are also employed to ascertain qualities by touch ; but the other parts of the body appear

insensible to feeling, either as regards the ascertaining of qualities or the sensation of pain.

534. Taste is undoubtedly possessed by insects in an eminent degree; and they seem to have the same preferences for animal or vegetable food which are evinced by vertebrated animals.

535. Smell appears to be the sense by which insects are led to discover strongly-scented substances at a great distance, where it is quite impossible that sight should aid them; its seat, however, is wholly unknown.

536. Hearing seems also to be possessed by insects, or to what purpose would the merry cricket sing his evening song, if there were none of his kind to listen to, and admire it? The seat of this sense is also wholly unknown.

537. Sight is a sense of which we have abundant evidence; it is seated in two large compound eyes, often occupying nearly the whole head, and also occasionally in three minute simple eyes, situated in a triangle on the crown of the head.

538. The mind of insects is more wonderful than our own: it has no speculation, no retention, no judgment, no power; it is, in fact, an existence which comes perfect from the Creator: the new-born bee is perfectly mistress of architecture; she is heaven-instructed: the mind is not only the ruling sense, but is a distinct immaterial element.

CHAPTER VIII.

OF THE ALIMENTARY CANAL, OR ORGANS OF
DIGESTION.

539. THE alimentary canal in insects, as in higher animals, consists of three principal parts, the gullet, the stomach, and the intestines.

540. The gullet (*œsophagus*) is the part which most nearly approaches the head, and the external opening of which is the throat (*pharynx*) already described; it is of various length; and in this particular it appears more influenced by the variation of external form than by the quantity or quality of food consumed.

541. The gullet is simple (*œsophagus simplex*) when it is merely a tube of uniform size extending from the pharynx to the entrance of the stomach: this is the usual structure.

542. The gullet is ventricose (*œsophagus ventricosus*) when it dilates into a large bag or crop before its union with the stomach, and detains the food in its passage to that organ.

543. The gullet is compound (*œsophagus*

compositus) when it has a long pear-shaped cell opening from it, and extending beneath the stomach and intestines, yet having no communication with either: this is the case in all the flies and gnats which feed on blood, and many of the same tribes which subsist on other fluids: the blood sucked is at once received into it; and, as enough is frequently swallowed at a single meal to last for days, it returns slowly to the gullet as required, and then passes to the stomach for digestion.

544. The stomach (*ventriculus*) receives the food immediately from the gullet, digests it, and passes it on to the intestines.

545. The food immediately on entering the stomach, combines with, or is pervaded by, some fluid secreted by the stomach; this fluid probably serves to assist in digesting the food, for it immediately undergoes a change in consistence as well as colour.

546. The stomach varies greatly in the form and nature both of its main cavity and of the numerous appendages with which it is occasionally furnished.

547. The stomach is simple (*ventriculus simplex*) when it is a mere continuation of the gullet in an enlarged form, being slightly restricted at the union with the gullet, and more so at its junction with the intestines, where an elastic ring is placed, which, when contracted, nearly closes the aperture.

548. The stomach is double (*ventriculus duplex*) when it is divided into two distinct portions, one preceding the other: in this instance the anterior portion appears the principal organ of digestion, and in form, as well as office, frequently appears to resemble the gizzard of birds; the posterior portion corresponds with the stomach in its usual simple form.

549. The stomach is triple (*ventriculus triplex*) when it possesses three separate divisions following each longitudinally: it sometimes, but rarely, has four or more of these divisions.

550. The stomach is compound (*ventriculus compositus*) when it throws off two or more minor stomachs (*cæca*), resembling little purses, at or near its union with the gullet; these are particularly observable in the voracious herbivorous insects, which have the anterior portion of the stomach in the form of a gizzard.

551. The stomach varies also in the character of its interior surface; it is sometimes perfectly smooth, and sometimes covered with a pilosity more or less shaggy; this pilosity has been said to consist of minute tubular processes, which secrete the fluid for digestion.

552. The stomach, at its posterior extremity, unites with the intestines; these consist of two portions, the small intestines (*intestina parva*), and the terminal intestine (*rectum*).

553. The whole of the alimentary canal, from

its anterior to its posterior opening, is frequently little more than a direct tube or cylinder; the intestines are never subject to the convolutions so general in vertebrated animals; the passage of the food is excessively rapid, and the change it undergoes very slight.

554. There are, originating from the stomach, at or near its union with the intestines, several long tortuous filiform appendages, which are said to be bile vessels, and to correspond with the liver of vertebrated animals.

CHAPTER IX.

ON THE ORGANS OF CIRCULATION.

555. IN vertebrated animals the heart is situated in the anterior part of the trunk; through the heart the whole of the blood contained in the body is supposed to pass: all the arteries and veins originate or terminate in the heart: the arteries and veins are the organs of circulation.

556. We find, that in insects, there is no part positively ascertained to be the heart; but we discover blood-vessels throughout the body, and we trace them to a series of large reservoirs, which form a connected line or channel the whole length of the insect.

557. The blood of insects is a thin, transparent, colourless fluid; it contains a quantity of oval particles which appear perfectly consistent, yet are as transparent as the fluid portion: a small portion of the blood dried on a glass presents a crystallized appearance.

558. The best objects in which to observe the

circulation of this blood, are transparent aquatic larvæ; and these being distinctly divided into the usual thirteen segments, afford us also the means of establishing a nomenclature.

559. The number of reservoirs composing the great channel is twelve, one to each of the segments, except the head; these, not having been hitherto named, may be called little hearts (*coracula*), and each one may be designated by the name of the segment in which it is situated, as the corculum of the telum (*teli corculum*).

560. Each corculum is somewhat pear-shaped, the smaller or pointed extremity being directed towards the head of the insect, and fitting to a cavity in the corculum above it, which cavity exactly corresponds, except in its being somewhat deeper and more pointed, to what is called the eye of a pear: twelve pears thus placed in a line, each closely touching the one above it, would give a general idea of the twelve corcula.

561. Each corculum has a most distinct, tough, and elastic coat, like that of an artery; the interior appears to be wholly filled with blood; the apertures of each corculum are two, one of them at each extremity.

562. The posterior aperture is occasioned by the pressure of blood from below, causing the point of the corculum to open; the aperture itself is surrounded by an elastic ring, which expands and closes with each pulsation.

563. To be distinctly understood, *Fig. 1*, it will be necessary to select two particular corcula, and describe their motions; for this purpose we will take the two most readily observed, the twelfth and thirteenth (*parateli corculum*, and *teli corculum*). *Fig. 1* represents these in a state of contraction (*systole*).



564. At the junction of each corculum with the next, are two great veins; these empty their contents into the corculum above them, and may be called the right and left veins of that corculum; those represented, *Fig. 1*, *c* and *d*, being the veins of the twelfth corculum (*parateli corculi vena*): these have no such distinct coats as those of the corcula.

565. The posterior extremity of *Fig. 2*, the twelfth corculum (*Fig. 2, a*), the anterior extremity of the thirteenth (*Fig. 2, b*), and the two veins (*Fig. 2, c* and *d*), open simultaneously, and the blood rushes upwards, both from the veins and the thirteenth corculum, into the twelfth, which instantly dilates. *Fig. 2* represents the twelfth, or upper corculum, in a state of dilatation (*diastole*).



566. The systole and diastole of each corculum take place alternately; so that when the whole

series of corcula is under the view, it assumes the appearance of an undulating line, the dilated portion passing upwards by the most regular pulsation: the rate being in the larvæ we have most examined, (that of an *ephemera*,) about sixty pulsations per minute.



3. 567. When the twelfth corculum has attained its state of greatest dilatation, the anterior portion is forced upwards by the commencing dilatation of the thirteenth, and by this movement the mouths of the lateral veins are completely closed, the blood continuing to flow upwards from the thirteenth corculum only. *Fig. 3* represents the twelfth and thirteenth corcula in this state.

568. The whole of the blood thus received from the veins into the corcula, and by one corculum from another, passes upwards towards the head of the insect, and, therefore, the only arteries issue from the first or anterior corculum.

569. From this corculum, arteries proceed to all parts of the body; minor ones supply the head and antennæ, while major ones turn downwards through every part of the insect, terminating in the lateral regions of each segment, and here, through the medium of the organs of respiration, communicating with the air.

570. The course of arteries on each side of the

insect, through every one of the segments, may be most distinctly traced, and the course of veins also intermingling with them. Both kinds of vessels are proportionately much larger than in vertebrated animals: in the interior their limits are vague and difficult to define, but in the lateral portions their exact course is readily ascertained.

571. The grand veins are twenty-four in number, two opening into each corculum; those which open into the eleven upper corcula seem to have almost an infinity of supplementary branches, extending little beyond a single segment; while those of the two last corcula flow from the head itself, throughout the whole length of the insect.

572. In the setiform appendages of the telum, the circulation is strikingly exhibited: here the ascending artery and descending vein accompany each other; and at the same instant the blood ascends an artery with the usual pulsatory motion, it is flowing in like manner down the vein.

573. In the nervures of the wings of insects, the course of the arteries and their attendant veins are readily traced: the femora and tibiæ also have a most distinct flowing and returning current; in fact, there is no part of an insect in either the larva or imago state, provided the microscope can reach it, but exhibits most distinctly the circulation and pulsation of the blood.

CHAPTER X.

OF THE ORGANS OF RESPIRATION.

574. IN vertebrated animals, the lungs are situated in the anterior part of the trunk: the whole of the air that is appropriated to the uses of the body must be inspired by the trachea, which ascends from the lungs to the mouth and nostrils: the trachea and lungs are the organs of respiration.

575. We find that in insects there is no part appropriated solely to the organs of respiration, but that they permeate every part of the body, mixing with the blood-vessels, and, as we might say, seeking the blood, in order to aërate it, instead of the blood seeking the organs of respiration by rushing into the lungs, as it does in vertebrated animals.

576. The organs of respiration in insects consist of simple tubes, which communicate externally with the air, and internally with the blood: the utility to all animals of imbibing air appears

to be owing to its action on, or incorporation with, the blood.

577. The air tubes of insects (*tracheæ*) communicate with the air by means of apertures which occur at intervals along the sides of insects; these apertures, which are called spiracles, are very various in their form, size, and number.

578. The spiracles (*spiracula*) are sometimes furnished with moveable lips, which the insects can close at pleasure, and thus exclude all injurious substances: sometimes they are furnished with a fringe of delicate hair, which answers the same purpose; and sometimes they are constantly open, and without any kind of protection.

579. The spiracles in those instances in which they are furnished with moveable lips, open and close with great regularity, the body at the same time expanding and contracting; a certain evidence that the motion of the spiracles is connected with respiration.

580. The spiracles are commonly oblong in their shape, but there are instances of circular, linear, quadrate, ear-shaped, and crescent-shaped spiracles.

581. The number of spiracles is generally eighteen, nine on each side; this number is possessed by almost all butterflies, moths, beetles, &c.; in flies there are not so many; in these, moreover, the number is not uniform.

582. The names of the spiracles depend wholly

on the segment in which they happen to be situated, as the right spiracle of the prothorax (*prothoracis spiraculum dextrum*): the fact of a segment possessing or not possessing spiracles is of importance in classification.

583. From each spiracle a single trachea enters the body; this single trachea is invariable; but the system of tracheæ within, are on various plans; the principal are the detached tracheæ, and connected tracheæ.

584. The tracheæ are called *detached* when, after entering the body as a single cylindrical tube, they separate, diverge, and ramify, throughout the region in their immediate vicinity, without any obvious connexion with the tracheæ of the adjoining spiracles.

585. The tracheæ are called *connected* when there is a grand longitudinal trachea traversing each side of the body throughout its length, into which each spiracle sends its particular tracheæ, sometimes as a single tube, sometimes after a slight ramification.

586. Whether the tracheæ possess the detached or connected form, their minute branches may be traced wandering over to the opposite side of the insect, and uniting with similar minute branches emanating from that side, so that the system of respiration is always connected, and acts by uniformity of impulse.

587. The ramifications of the tracheæ to our

perception, appear infinite ; they pervade the skin, muscles, nerves, stomach, intestines, legs, wings, and all the organs of sensation ; the organs of respiration are therefore more generally diffused in insects than in other animals.

588. The blood of animals, in order to maintain its vital powers, requires supplies of oxygen, which is a principal ingredient of atmospheric air : an animal, therefore, in breathing the air, divides the oxygen from the other constituent parts, appropriates the former, and rejects the latter.

CHAPTER XI.

CONCLUDING OBSERVATIONS.

589. THE transformation (*metamorphosis*) of insects requires a few words: every insect has at least three distinctly marked stages of life; the egg, or foetal; the larva, or adolescent; and the imago, or adult.

590. There is a fourth state which occurs in many, the pupa, chrysalis, or quiescent state of the larva; these changes are accompanied by a casting of the skin.

591. In the changes which insects undergo, not only is the external appearance altered, but the organs of support, motion, sensation, digestion, and generation are also altered, and frequently those of respiration.

592. The organs of support in insects are mostly external; they are not bones, but perform the functions of bones; no experiments have yet proved that they possess the least sensitiveness to

touch, except in a few parts in which the nerves obviously ramify to the surface.

593. The organs of motion in insects are enclosed within, and attached to, the organs of support; they are evident muscles, partly fleshy, partly tendinous, and differ in no material character from the muscles of vertebrated animals.

594. The organs of sensation in insects are distinctly and decidedly nerves, and in most respects resemble the nerves of vertebrated animals; they do not, however, originate in a common or concentrated brain, but in numerous incrassated bundles of nerves, which are now termed cerebroids.

595. The usual animal senses are possessed by insects; most of them obviously. Of hearing, we find slender proof, and its seat is altogether unknown; we also rather presume than know that insects possess smell; its seat is also unknown.

596. The organs of digestion in insects are peculiarly simple: the alimentary canal is very short, and the intestines generally without convolutions; the food passes very rapidly, and undergoes but little alteration.

597. The organs of circulation are these: a longitudinal series of little hearts, now termed *corcula*, of arteries, and of veins; the blood is transparent and colourless, it contains numerous consistent oat-shaped particles; it flows very

regularly, with a distinct pulse, in every part of the body.

598. The organs of respiration are tubes permeating the whole body, and communicating with the air by means of lateral spiracles or openings in the side of the insect.

599. The organs of generation in insects are situated in the last segment almost invariably. Insects are of two distinct sexes, male and female; those called neuters are abortive females.

600. Insects are long in proportion to their breadth: they are transversely divided into thirteen segments; each segment seems to possess in itself a distinct vitality.

601. Insects are excessively tenacious of life, even to so great a degree, that heads separated from the body have eaten voraciously for hours, the food passing completely through them; and bodies without heads have occasionally fled, and have repeatedly walked about for days.

602. Insects appear to possess no mental power; to be incapable of memory; to assume the winged state in the plenitude of perfection; to perform the acts their parents performed without the possibility of tuition or observation.

603. The author is aware that several repetitions occur in the course of this book, but they appeared to him essential to make the subject perfectly clear; he hopes that those who do not see the necessity of these repetitions will yet pardon them.

604. More would have been said on the seventh system of organs, but the popular character of an introductory work of this kind seemed to render it unnecessary, and therefore unadvisable.

END OF THE PHYSIOLOGY OF INSECTS.





Fig 1



Fig 2



Fig 6



Fig. 3.



Fig 4



Fig 7



Fig 10.

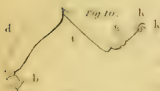


Fig 11

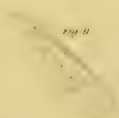
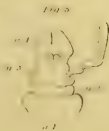


Fig 8



Fig 9



THE
GRAMMAR
OF
ENTOMOLOGY.

BOOK III.
CLASSIFICATION OF INSECTS.

Order is Heaven's great law.



BOOK III.

CLASSIFICATION OF INSECTS.

CHAPTER I.

CLASSIFICATION OF INSECTS IN GENERAL.

605. EVERY one must have observed that there is a greater resemblance between some two of the various insects with which he is acquainted, than between some other two : thus a butterfly more nearly resembles a moth, than a moth resembles a beetle, or than a butterfly resembles a beetle. Again, two different kinds of butterfly more nearly resemble each other, than either of them resembles a moth ; the same with two moths ; and the same with two beetles.

606. As an illustration, therefore, of system, we will arrange these six thus : butterfly, butterfly, moth, moth, beetle, beetle ; no one with the slightest idea of similarities, would place the

beetles between the moths and the butterflies ; neither would any one place one of the moths, or butterflies, between the two beetles : thus the most untaught mind acknowledges the existence of a system.

607. Resemblances, in natural history, are not dependent on the outward and obvious distinctions of size and colour, but are to be traced in other characters ; in economy, habit, and structure. Economy comprises the acts of a living being, as described in the First Book of this volume ; structure is described in the Second Book ; and habit is the external form and appearance ; in fact, the result of structure.

608. In arranging, it is necessary to consult all these characters, but principally structure, because, under all circumstances, we gain some knowledge of this ; whereas, habit may be occasionally altogether deformed, and economy frequently altogether unknown : in structure, primary variations occur in the systems of organs ; secondary variations in the details, which comprise a system of organs.

609. In all animals, the bones, or organs of support, and the covering of the surface of the body, as skin, hair, feathers, or scales, afford the most ready characters by which to distinguish different kinds of animals from each other : now, in insects, we have seen that the organs of support are on the surface of the body, and, therefore,

present greater facility to the describer than any other animals.

610. When the known animals shall be so arranged that each one is placed nearest to the one which it most resembles, and a series thus formed from which none shall be excluded, then the arrangement will be perfect, and the natural system will be discovered: this has been the ultimate object of naturalists in all ages.

611. In any abstract science, there is an evident advantage in being able to determine the names of every object, or group of objects; and so to allude to either, in speaking or writing, as that all persons possessing a moderate knowledge of the science may at once form a definite idea of what is meant.

612. The power of intelligibly designating an object, or a group of objects, is only to be attained by a close attention to nomenclature; science is of no country: nomenclature should, therefore, be entirely in a language common to all countries; and, by common consent, Latin has been adopted as the language of science.

613. In nomenclature, it is a sound plan to revert to some standard authority; and, supposing objects at any time subsequent to that authority be described and named as new, to strike out such new names as soon as the fact shall be pointed out, and substitute the old names in their right of priority: in all instances

subsequent to such authority, the best rule is, that the name first published be received.

614. Naturalists are agreed in considering Linnæus the original founder of a distinct and applicable nomenclature, and, with very few exceptions, they refer to him as the standard authority: the author has adhered, as nearly as possible, to the Linnæan nomenclature, altering, however, the termination of the names, in order to appropriate the original names to minor divisions.

615. For convenience, we make catalogues of all known animals: it is the object of every compiler of such catalogues to make as near an approach to nature as he is able. These catalogues, or arrangements, are not limited to a simple list of single names or kinds of animals (*species*), but many species are grouped together under a second name, called a genus (*genus*); a number of genera are united, and called a family (*familia*); a number of families are united and called an order (*ordo*).

616. From orders we mount upwards to stirpes (*stirpes*); from stirpes to classes (*classes*); from classes to tribes (*tribus*); from departments to provinces (*provinciæ*); from provinces to kingdoms (*regna*); and, from kingdoms, to universal nature.

617. It may be remarked, that all divisions have a tendency to subdivide into the numbers

four and seven ; in other words, to contain four groups, three of which shall be double groups, and one single group : this circumstance has led to much argument as to the superiority of the particular numbers, two, four, and seven. Some writers have also contended for the numbers three and five.*

618. The relative position in which the objects of nature stand, has been also the subject of great discussion ; some authors contending that the system of nature is represented by a straight line ; others, by the branches of a tree ; others, by the circumference of a circle. No decision on either number or position has yet been made by naturalists ; indeed, it is the general opinion, that no particular number or position is constant in nature.

619. The author ventured to suggest, in a little essay, published some time since, that seven was the predominant number ; and that, in every group of seven, whether the group be large or small, one of the seven is central, and the other six surround it, and are each connected with it : this is called the septenary system.

620. The septenary system has not been generally received ; on the contrary, it has been written against with what the author thinks

* The principal advocates of particular numbers are these : Fleming, *two* ; Swainson, *three* ; Cuvier, *four* ; Mac Leay, *five* ; the author, *seven*.

unnecessary severity ; unnecessary, because temperate argument, and persevering inquiry, do more to elicit truth, and fair, moderate statements, more to establish it, than angry words and flat contradictions.

621. The author may, perhaps, be allowed to add, that though almost alone in the belief, he still believes that the septenary system is the system of nature ; but he is not inclined to argue the subject further, and if he were, this is not the place : he leaves the subject to those who feel disposed to prosecute the inquiry ; the truth must, eventually, make its way.

622. Universal nature is divisible into material and immaterial : the material is divided into organic and inorganic ; the organic is divided into animal and vegetable : these are called kingdoms (*regna*) ; and the whole of the animals thus constitute the animal kingdom : the inorganic division, like the organic, is double : of the immaterial we all are ignorant.

623. The animal kingdom is distributed under four great divisions, distinguished from each other by organization. One of these is a single group, the other three are each double groups ; that is, they each contain two groups, both of which possess the essential characters of the division, but which, nevertheless, widely differ in some subordinate character. These divisions, whether considered as four or seven, may be termed provinces : they are these :—

624. Vertebrated animals (*vertebrata*). In this division, which is that of man, and of the animals most resembling him, the brain and principal trunk of the nervous system are enclosed in a bony envelope formed by the cranium and vertebræ; to the sides of this intermedial column are attached the ribs and bones of the limbs, which form the frame-work of the body; the muscles generally cover the bones, whose motion they occasion: this is a single group.

625. Molluscous animals (*molluscata*). In this division there is no skeleton; the muscles are merely attached to the skin, which constitutes a soft contractile envelope, in which, in many species, are formed stony plates, called shells. The nervous system is contained within this general envelope, and is composed of several scattered masses connected by nervous filaments: this is a double group.

626. Annulated animals (*annulata*). In this division the nervous system consists of long cords, running longitudinally throughout the body, and dilated at intervals into knots or ganglions. The covering or envelope of the body is divided by transverse folds into a certain number of rings, whose teguments are sometimes hard, sometimes soft; the muscles are situated intervally: this is a double group.

627. Radiated animals (*radiata*). The organs of sensation and motion, in the preceding divisions,

are symmetrically arranged on the two sides of an axis; in this division, these organs are disposed like rays round a centre; their respiratory organs are seated on the surface of the body: many animals of this division are a mere homogeneous pulp: this is a double group.*

628. It will be evident to every one who has read the preceding Book, that insects must belong to the third of these divisions—the annulated animals. This division comprises two very distinct groups: *first*, worms (*apoda*), which have soft bodies without legs; *secondly*, condylopoes (*condylopoda*), which have their bodies in a hard case, and have articulated legs.

629. The province of condylopoda is divided into tribes by the number of legs, thus: insects (*hexapoda*) have six legs; spiders (*octopoda*) have eight legs; shell-fish, as crabs (*anisopoda*), have from ten to eighteen legs; and centipedes (*myriopoda*), which have twenty to two hundred legs: the last is a single group; each of the others, double.

630. Insects are divided into two tribes, by the circumstance of possessing wings or wanting them; those which have wings are termed winged insects (*tetraptera*); those which are without wings are termed wingless insects (*aptera*).

631. The winged insects are again divided into

* The characters of the four provinces of animals are from Cuvier's "Regne Animal."

four classes, founded on the mode of metamorphosis ; that is, on the degree of similarity which the larva and pupa states bear to the perfect state : as in the preceding higher division, three of these are double classes, and one is a single class. Insects are termed amorphous (*amorpha*), in which there is no resemblance between the pupa and imago ; necromorphous (*necromorpha*), in which there is a similarity, though imperfect ; isomorphous (*isomorpha*), in which the similarity is complete ; and anisomorphous (*anisomorpha*), in which there is great variation of metamorphosis, although a general similarity of structure in the perfect state.

632. The winged insects are also divided into seven classes : the amorphous insects comprise two of these minor classes, called *lepidoptera* and *diptera* ; the necromorphous insects comprise two classes, *hymenoptera* and *colcoptera* ; the isomorphous insects comprise two classes, *orthoptera* and *hemiptera* ; and the anisomorphous insects have only a single class, *neuroptera*.

633. It is of great importance to adhere to some fixed nomenclature of divisions, and to understand the various steps as we mount from *species* to *kingdoms*. To recapitulate, they are these :—
1. Species ; 2. Genus ; 3. Family ; 4. Order ;
5. Stirpes ; 6. Class ; 7. Tribe ; 8. Province ;
9. Kingdom : and be it recollected, the number of the minor groups constituting a major group, need make no variation in the name of either group.

634. SUMMARY.

Provinces of the Animal Kingdom—Four or Seven.

Province	I. Molluscata, or	{	Prov. I. Cephal?
			II. Acephala?
	II. Radiata, or	{	III. Actinita.
			IV. Acrita.
	III. Annulata, or	{	V. Apoda.
			VI. Condylpoda.
	IV. Vertebrata, or		VII. Vertebrata.

Tribes of the Condylpoda—Four or Seven.

Tribe	I. Hexapoda, or	{	Tribe	I. Tetraptera.
				II. Aptera.
	II. Octopoda, or	{		III. Arachnoida.
				IV. Acaroida.
	III. Anisopoda, or	{		V. Entomostraca.
				VI. Malacostraca.
	IV. Myriapoda, or			VII. Myriapoda.

Classes of the Tetraptera—Four or Seven.

Class	I. Amorpha, or	{	Class	I. Lepidoptera.
				II. Diptera.
	II. Necromorpha, or	{		III. Hymenoptera.
				IV. Coleoptera.
	III. Isomorpha, or	{		V. Orthoptera.
				VI. Hemiptera.
	IV. Anisomorpha, or			VII. Neuroptera.

CHAPTER II.

OF THE CLASSIFICATION OF LEPIDOPTERA.

635. CHARACTER amorphous: *i. e.* larva and pupa bearing no resemblance in external appearance to the imago: pupa perfectly quiescent, having the limbs and parts of the mouth enclosed with the body, in a hard brittle skin or case.

636. Larva with strong corneous mandibles, moving horizontally, and six articulated feet, situated in pairs on the second, third, and fourth segment: the fifth and sixth, eleventh and twelfth segments invariably with feet: the other segments each subject to the possession of a pair of fleshy prehensile feet: feeds on the leaves, bark, wood, or roots of vegetables, and rarely on other larvæ.

637. Imago with short, undeveloped, immovable labrum and mandibles; elongate palpigerous maxillæ, slender, flexible, and tubular; when at rest, convoluted between the labial feelers; labium triangular, bearing two erect conspicuous feelers: all the wings fully and nearly equally developed,

and, together with the body, clothed with scales : feeds on the honey of flowers, and on fruit.

638. The class Lepidoptera contains seven stirps, but as the characters will be given minutely in detail, as characters of orders, it would be of little use giving them as those of stirps. By the summary at the end of this Book, it will be seen to what stirps each order belongs. The orders of Lepidoptera, are these:—

639. Hawk-moths (*Sphingites*). Larva naked, of uniform substances, with ten prehensile legs, and a stout corneous recurved horn on the paratelum. Pupa smooth, rounded, generally quite naked ; changes in or on the ground. Imago with the antennæ incrassated in the middle ; the tips furnished with a recurved hook composed of fine bristles ; wings narrow ; hind wings small ; body stout ; flight rapid and well sustained ; diurnal or nocturnal. British Genera, *Sesia*, *Macroglossa*, *Smerinthus*, *Sphinx*, *Acherontia Deilephila*.

640. Skippers (*Hesperites*). Larva generally naked, stout in the middle, and attenuated at the extremities with ten prehensile legs. Pupa stout, smooth, unangulated ; changes in a loose web among the leaves on which the larva feeds, attached by the tail and a thread round the middle. Imago with the antennæ partially elevated ; sometimes nearly filiform, hooked at the extremity ; the hind wings of the insect, when at

rest, reposing in a nearly horizontal position; the fore wings nearly erect: flight diurnal, brisk, and bustling. *Hesperia*, *Thymele*.

641. Butterflies (*Papilionites*). Larva sometimes naked, but generally covered with down, hair, or spines: with ten prehensile legs. Pupa naked; mostly angulated, always attached by the tail; changes in the air. Imago with clavated antennæ not hooked; all the wings erect, and meeting above the back when at rest. *Polyommatus*, *Lycæna*, *Thecla*, *Amaryssus*, *Colias*, *Pontia*, *Apatura*, *Limenitis*, *Hipparchia*, *Vanessa*, *Argynnis*.

642. Loopers, or slender bodies (*Geometrites*). Larva naked, slender, and very elongate, with four prehensile feet; in consequence of the length of body without feet, its back is arched in walking. Pupa smooth, rounded; situation of change, various. Imago with antennæ tapering to a point; in the males often highly pectinated; wings ample, expanded; body very slender; flight in the evening, silent, feathery. *Geometra*.

643. Half-loopers (*Phytometrites*). Larva naked, elongate, less slender than the preceding, with six prehensile feet; in walking its back is arched, but not so decidedly as in the preceding. Pupa smooth, rather pointed at the tail; changes in a slight web. Imago with filiform antennæ; wings deflexed; moderately stout body; beautifully coloured: often with brilliant metallic

markings; flight at all hours; in the hottest sunshine, and at midnight. *Plusia*, *Ophiusa*, *Heliothis*, *Acontia*, *Erastria*, *Phytometra*.

644. Full-bodied moths (*Noctuities*). Larva generally naked, cylindrical, robust, with ten prehensile feet: rolls in a ring when touched. Pupa smooth: mostly changes in the ground. Imago with filiform antennæ; occasionally pectinated in the males; wings small, deflexed; body stout and heavy; colour dusky; flight very rapid; nocturnal. *Brepha*, *Catocola*.

645. Millers (*Arctiites*). Larva very hairy; sometimes with bunches, brushes, or fascicles of hairs; with ten prehensile legs; rolls in a ring when touched. Pupa more or less hairy; changes in a cocoon composed of silk, in which the hairs of the larva are always intermixed. Imago, the males with somewhat slender bodies; more or less pectinated antennæ, and active; often flying by day; the females very heavy, sluggish, and often apterous. *Acronycta*, *Spilosoma*, *Arctia Hypercampa*, *Lithosia*, *Hypogymna*, *Laria*, *Orgyia*.

646. Eggars (*Bombycites*). Larva elongate, cylindrical, of equal substance, hairy, with ten prehensile feet, rolls in a ring when touched. Pupa in a silken cocoon, more close than the preceding. Imago with pectinated antennæ in both sexes; males with slender bodies, very active, and fly by day; females heavy, sluggish, and seldom

fly; predominating colour, fulvous. *Eriogaster*, *Odonestis*, *Gastropacha*, *Lasiocampa*.

647. Emperor-moths (*Phalaenites*). Larva obese, with fascicles of bristles disposed in rings on each segment. Pupa short, obtuse, flat, with bristles at the tail; changes in a tough pear-shaped cocoon, of which the smaller end remains open. Imago with highly pectinated antennæ in both sexes; wings amazingly expanded; the fore wings more or less falcate; beautifully coloured, and ocellated; body short and small; flight of the males diurnal, of the females rare, and mostly in the evening. *Saturnia*.

648. Prominents (*Notodontites*). Larva generally naked; sometimes slightly downy; attenuated towards the tail, with eight prehensile feet; the two posterior ones being mostly wanting, and the segment usually bearing them elevated in the air. Pupa smooth, obese, compact; mostly changes in a cocoon or web, but occasionally on or in the ground. Imago with the antennæ of the males more or less pectinated; wings deflexed; flight, with few exceptions, in the evening. *En-dromis*, *Cerura*, *Stauropus*, *Platypteryx*, *Cilix*, *Notodonta*, *Pygæra*, *Clostera*.

649. Wood-eaters (*Xyleutites*). Larva depressed, rather attenuated towards either extremity; naked, except a few scattered hairs; prothorax flat and corneous; ten prehensile feet; feeds on the bark, solid wood, pith, or roots of vegetables. Pupa

furnished with a double row of short spines on each segment; it changes in a tough cocoon amongst its food, after remaining through the winter in the larva state. Imago with the antennæ of the males more or less pectinated; flight nocturnal. *Hepialus, Xyleutas, Zeuzera.*

650. Clear-wings (*Ægeriites*). Larva and pupa, in habit and economy, precisely as in the preceding. Imago with antennæ incrassated externally, and the tip furnished with a slightly recurved hook, consisting of a few bristles; in the males ciliated; wings narrow, mostly transparent; body elongate, slender, and tufted; flight diurnal, in the hottest sunshine, and eminently graceful. *Ægeria.*

651. Burnet-moths (*Glaucopites*). Larva obese, hairy, with ten prehensile legs. Pupa smooth, very glossy; changes in a close gummy cocoon, pointed at both ends, and attached generally to a blade of grass. Imago with clavate antennæ; slightly pectinated in the males. *Zygæna, Ino.*

652. Pearl-moths (*Pyalites*). Larva rather more slender than the foregoing, slightly hairy, with ten prehensile feet. Pupa elongate, very lively; changes in a silken cocoon. Imago with filiform antennæ; wings somewhat triangular, deflexed: legs very long, and furnished with long spurs. *Ennychia, Pyrausta, Hydrocampa, Botys, Scopula, Pyralis, Polypogon, Hypena.*

653. Veneer-moths (*Crambites*). Larva elongate, naked, with ten prehensile feet. Pupa elongate; changes in a slight cocoon. Imago with very prominent labial feelers, filiform antennæ, sometimes pubescent; wings ample, folded round the body; flight in the evening. *Crambus*, and allied genera.

654. Ermine-moths (*Yponomeutites*). Larva elongate, slightly hairy, with ten prehensile feet; gregarious, spinning a web; if touched, runs backwards, falls and suspends itself by a thread. Pupa elongate, smooth; changes in a cocoon amongst its food. Imago with filiform antennæ; wings folded round the body, often beautifully dotted and marked with black. *Yponomeuta*, and neighbouring genera.

655. Bell-moths (*Tortricites*). Larva more obese than the foregoing, slightly hairy, with ten prehensile feet; gregarious, spinning a web; if touched, runs backwards with a rapid twisting motion, and falls, hanging by a thread. Pupa elongate, attached by the tail; changes in a silken cocoon, generally amidst the web of the larva. Imago with filiform antennæ; the fore wings with a prominent shoulder, which gives the insect, when at rest, precisely the shape of a bell. *Tortrix*, and allied genera.

656. Clothes-moths (*Tineites*). Larva elongate, with ten prehensile legs; concealed in a sack constructed by itself, which it enlarges from

time to time as it increases in bulk ; feeds on woollen cloths, hair, and decayed animal and vegetable substances. Pupa elongate ; changes within the sack. Imago with filiform antennæ, and narrow wings ; flight gregarious, rising and falling. *Tinea*, and allied genera.

657. Plume-moths (*Alucitites*). Larva slender, with ten prehensile feet ; the anterior part capable of great attenuation and extension, in the manner of a leech. Pupa elongate ; changes in a silken cocoon. Imago with filiform antennæ ; wings extended at right angles with the body ; very narrow, and divided to the base, each division having the appearance of a perfect and distinct feather. *Pterophorus*, *Alucita*.

CHAPTER III.

OF THE CLASSIFICATION OF DIPTERA.

658. IN the second class, Diptera, the metamorphosis, as in Lepidoptera, is amorphous. Larva with minute corneous mandibles, moving horizontally; without articulate or prehensile feet; feeds on recent or decaying animal and vegetable substances.

659. Imago of Diptera with the parts of the mouth variously developed; the mandibles never possessing the horizontal motion, or masticatory power; the fore wings fully developed; the hind wings undeveloped; assuming the appearance of small pedunculated knobs, and denominated halteres or poisers; tarsi five-jointed.

660. Wheat-flies (*Cecidomyites*). Larva elongate, feeds on the blossoms of wheat and other grain, the leaves of plants, &c. causing excrescences. Pupa changes in the same situation, in a tough case. Imago usually with moniliform

antennæ, as long as the body, composed of about twelve or thirteen joints in the female, and twice as many in the male; maxillary feelers four-jointed; ligula short, obtuse, and tomentose; wings wide, as long as the body, which they cover horizontally; female furnished with a long oviduct. *Cecidomyia*, *Campylomyza*.

661. Crane-flies (*Tipulites*). Larva stout, very soft, attenuated anteriorly, abruptly terminated posteriorly; feeds on the roots of corn, grass, and other vegetables, or occasionally decayed wood. Pupa changes in the same situations; it has often two remarkable recurved horns, porrected from its head, through which it is said to breathe; and the segments of the body are mostly armed with spines. Imago with antennæ thirteen to seventeen-jointed; frequently pectinated in the males; ligula fleshy, bilobed, dilated; maxillary feelers five-jointed, curved, the points turning outwards; ocelli none. *Ctenophora*, *Pedicia*, *Tipula*, *Erioptera*, *Limnobia*.

662. Fungus-flies (*Mycetophilites*). Larva elongate, glabrous; feeds on decaying fungi. Pupa changes in the same situations. Imago with antennæ sixteen-jointed, sometimes very long, moniliform, and simple in both sexes; ligula and other organs of the mouth obscurely developed or obsolete; ocelli three; wings rather wide, cover the body horizontally; body very slender, the same length as the wings; legs

long. *Bolitophila*, *Macrocera*, *Synapha*, *Mycetobia*, *Platyura*, *Sciophila*, *Leia*, *Mycetophila*, *Molobrus*, *Lestrema*, *Zygoneura*.

663. *Rhyphites* (*Rhyphites*). Larva very elongate, smooth, cylindrical, encompassed by eleven corneous shining rings; head furnished with two hooks; tail with four short cylindrical tubes: inhabits the earth and cow-dung. Pupa changes in the earth. Imago with filiform, sixteen-jointed, antennæ, rather longer than the head; ocelli three; maxillary feelers four-jointed; ligula distinctly bilobed, other parts of the mouth not fully developed; wings broad, lying horizontally on the body, which they much exceed in length. *Rhyphus*.

664. *Bibionites* (*Bibionites*). Larva elongate, attenuated at each extremity; divisions of the segments deeply marked, and fringed with hairs; head furnished with two obtuse hooks: inhabits earth, on which it appears to feed. Pupa changes in the earth. Imago with short, nine-jointed, antennæ; maxillary feelers four or five-jointed; ligula pubescent and bilobed, the other parts of the mouth obsolete; head and eyes large in the male, small in the female; ocelli three. In the spring and autumn every lane and meadow swarms with these insects, either sailing in the air like balloons, or settled on vegetables. *Bibio*, *Dilophus*.

665. *Scatopsites* (*Scatopsites*). Larva and

pupa unknown. Imago with antennæ cylindric-conic, acute, twelve-jointed; ligula small, pubescent, and bilobed; maxillary feelers very short, exarticulate. Inhabits flowers; is sluggish in its movements. *Scatops*.

666. Mosquitoes (*Simuliites*). Larva aquatic; supposed to feed on vegetable substances; elongate, cylindrical, incrassated posteriorly, semi-transparent. Pupa also aquatic, but quiescent; ovate, gibbous, brown-coloured, clearly exhibiting all the parts of the future imago. Imago with antennæ eleven-jointed, very short; maxillary feelers elongate, incurved, composed of four distinct joints, the fourth very long and pointed; the labrum, mandibles, and maxillæ sharp and wedge-shaped; the ligula fleshy and bilobed; ocelli none; wings very wide, with stout costal nervures, and scarcely any elsewhere; mesothorax globose, very prominent; body short and small, colour black. Inhabits woods, feeding on the blood of man and animals. *Simulia*.

667. Gnats (*Culicites*). Larva elongate, carnivorous, active, aquatic. Pupa equally active, but rather shorter, and the head and prothorax much incrassated. Imago with fourteen-jointed antennæ, plumose in the males, hairy in the females; ligula slender and elongate, forming, together with the mandibles, maxillæ, tongue, and labrum, a porrected blood-sucking apparatus; the maxillary feelers are long, divaricating, and clavate;

all the organs of the mouth exceed the antennæ in length; ocelli none; wings linear, covering the body; body narrow, linear, elongate; legs very long. Inhabits woods, &c. entering houses; feeds on the blood of man and quadrupeds. *Culex*, *Anopheles*, *Chironomus*, *Tanypus*.

668. Moth gnats (*Psychodites*). Larva inhabits and feeds on putrescent fungi, &c. Pupa changes in the same situation. Imago with antennæ filiform, and perfectly simple, alike in both sexes; ligula short, entire, somewhat pointed; wings deflexed, very hairy, enveloping the body laterally, and their inner margins uniting above it. *Psychoda*.

669. Bald-headed flies (*Cyrtites*). Larva and pupa unknown. Imago with antennæ seven-jointed, entirely concealed, so that the head appears perfectly globular; the basal joint is short and small, the second stout, and the remaining five united into one, which is very acute at the apex, and somewhat incrassated at the base: ligula, a slender tube; ocelli three; wings longer than the body, but too narrow to cover it; alulæ large; prothorax and body very globose. Inhabit white thorn, furze, rushes; very seldom fly, and appear exceedingly sluggish. The body is so soft as to indent on the slightest pressure. *Henops*, *Acrocera*.

670. Unicorn flies (*Bombiliites*). Larva and pupa inhabit the earth. Imago with antennæ

composed of seven joints; the basal and second joint short; the apical portion long, linear, and consisting of five united joints, of which the terminal one is acute; ligula, very long, rigid, and porrected like a horn; ocelli three; wings widely divaricating, narrow, variegated; alulæ small; legs long, slender; body short, globose, very hairy. Inhabits lanes and woods, hovering over flowers, &c. *Bombylius*.

671. Gad-flies (*Tabanites*.) Larva inhabits the earth; is elongate, cylindrical; head corneous, linear, elongate, and furnished with two hooks. Pupa changes in the earth; has two tubercles anteriorly, and six sharp points near the posterior extremity. Imago with antennæ composed of seven joints, the basal joint long and rather stout, the second minute, the remaining five of various dimensions and sizes, differing in the different genera; ligula large, bilobed, porrected; and the other organs of the mouth very perfectly developed; ocelli none; wing divaricating, as long as the body; alulæ large; body flat; colour griseous: male feeds on the farina of flowers; females suck the blood of man and quadrupeds. *Tabanus*, *Hæmatopota*, *Chrysops*.

672. Painted winged flies (*Anthracites*). Larva and pupa unknown. Imago with the antennæ composed of seven joints; the basal joint long and stout, the second globular, and the remaining five frequently united into one; ligula large,

fleshy, bilobed, and rather porrected ; ocelli three ; wings somewhat divaricating, long, extending beyond the body, beautifully variegated with black or brown ; alulæ small ; body flattened, truncate at the extremity. Inhabits the borders of woods and heaths, settling on flowers. *Anthrax, Stygia*.

673. Piercing flies (*Stomoxites*). Larva and pupa unknown. Imago with the antennæ six-jointed, the basal and second joints short, the third produced inferiorly, pendulous, and received into a cavity in front of the head ; the remaining joints forming a seta which is often plumose ; ligula very elongate, and porrected in front of the head ; wings slightly divaricate ; alulæ very large ; body stout ; colour griseous or mottled. Inhabits woods, meadows, houses, &c., feeding on the pollen of flowers, and the blood of man and quadrupeds. *Stomoxys, Bucentes*.

674. Wasp flies (*Conopites*). Larva elongate ; feeds in the bodies of humble bees. Pupa changes in the same situations. Imago with antennæ placed on a distinct pedicle, six-jointed ; basal joint long, second and third long and incrassated, the remaining ones short and decreasing to a point ; ligula long, porrected ; wing narrow, divaricating ; alulæ obsolete ; body elongate, narrow, recurved. Inhabits woods, feeding on composite flowers, and occasionally, it is said, sucking the blood of cattle. *Conops*.

675. Botts (*Æstrites*). Larva cylindrical,

oblong; feeds in the stomachs, frontal cavities, or backs of quadrupeds; when full fed it falls to the ground. Pupa changes in the earth, or, if the larva inhabit the stomach, in the dung of the animal it has preyed on. Imago with six-jointed antennæ; basal and second joints short, scarcely distinct; third large, globose; the remaining three forming a seta, which is incrassated at the base; organs of the mouth obsolete; wings divaricating; alulæ moderately large; body pilose, short, stout. Inhabits meadows and commons, flying about cattle in order to deposit its eggs. *Æstrus*.

676. Ant-lion flies (*Leptites*). Larva elongate, rather attenuated at the anterior end; inhabits funnel-shaped holes, which it constructs in loose sand, to serve as a pitfall to small insects, on which it feeds. Pupa changes in the same situation. Imago with antennæ five-jointed; the basal, second, and third joints short, and somewhat globose, but varying much in the genera; the fourth and fifth closely united, and forming a long, slender seta; ligula large, membranous, bilobed; the maxillary feelers long, two-jointed, and porrected; ocelli three; wings long, divaricating, often spotted; alulæ obsolete. Inhabits moist hedges; preys on small insects. *Leptis*, *Atherix*, *Rhagio*.

677. Downy flies (*Therevites*). Larva very elongate, with two air-tubes at the posterior extremity, and the divisions of its segments very distinct;

inhabits moist sand, mud, and moss. Pupa changes in the same situations. Imago with the antennæ composed of seven joints; the basal joint longer than the second, the remaining five united into one, which is acute at the apex; the ligula is short, linear, and bilobed; the wings cover the body; alulæ obsolete; body very hairy. Inhabits the sand of the sea shore, roads, &c. making short flights: preys on small insects. *Thereva*.

678. Tiger flies (*Asilites*). Larva inhabits the earth; it is elongate, cylindrical, slightly depressed, very smooth, and has a corneous head, which is armed with two hooks: feeds on the minute insects which abound near the surface of the ground, especially at the roots of grass. Pupa smooth, anteriorly cylindrical, posteriorly conical; the body laterally, and at the extremity, is furnished with small spines. Imago with the antennæ five-jointed; the basal and second joints moderately long, the three forming the apical portion always distinct; the terminal joint acute, but not setiform; ligula large, cylindrical, and corneous; ocelli three; wings as long as the body, which they cover horizontally; alulæ obsolete; body elongate, hairy. Inhabit heaths, &c., settling on the ground, and preying on other insects. *Dasygogon*, *Asilus*, *Gonipes*.

679. Midas flies (*Midasites*). Larva and pupa unknown. Imago with the antennæ five-jointed; the basal joint long, the second short and nearly

globular, the three forming the apical portion united into an elongate, stout club, on which the union of the joints is marked transversely; ligula longer and more acute than in the *Asilites*; maxillæ and mandible acute; ocelli nearly obsolete; wings as in the *Asilites*; legs and body hirsute. Inhabits woods, forests, settling on leaves, &c., preying voraciously on insects, particularly *Hymenoptera*. *Dioctria*. *Laphria*.

680. Bird's-beaked flies (*Empites*). Larva and pupa unknown. Imago with antennæ five-jointed; the basal joint oblong, the second nearly globular, the three forming the apical portion often united, of different proportions in different genera; ligula very long, slender, recurved, contains elongate and acute maxillæ, &c. resembling very much the beak of a bird; ocelli three; wings large, particularly wide in the female; alulæ small or obsolete; body rather hairy, linear, slender. Inhabits woods, lanes, and gardens, preying on other insects. *Hilara*, *Gloma*, *Empis*, *Rhamphomyia*, *Hybos*.

681. Tachydromiites (*Tachydromiites*). Larva and pupa unknown. Imago with antennæ five-jointed; the basal and second joints oblong, the third elongate and robust, the fourth and fifth forming a seta, which is bent nearly at a right angle with the third; ligula short, bilobed; ocelli three; wings very large and wide, lying horizontally on the back; body rather pilose, short, stout-pointed. Inhabits woods, preying on minute

insects; black, brown, or fulvous. *Hemerodromia*, *Tachydromia*, *Platypalpus*, *Drapetis*, *Lonchoptera*.

682. Silvery flies (*Dolichopites*). Larva attenuate at the extremities, elongate; inhabits moist earth and mud. Pupa changes in the same situations. Imago with the antennæ five-jointed; the basal, second, and third joints robust, the fourth and fifth forming a seta; ligula very stout, short, and bilobed; ocelli three; wings very large, lying horizontally over the body; alulæ obsolete; legs very long; body short and small; green, with a silvery pilosity. Frequents damp places, preying upon small insects. *Porphyrops*, *Chrysotus*, *Dolichopus*, *Medeterus*.

683. Wood-eating flies (*Xylophagites*). Larva elongate, inhabits decaying wood. Pupa changes in the same situations: in a cocoon. Imago with the antennæ ten-jointed; the basal and second joint are short, moderately robust, and hairy; the portion corresponding to the apical seta of the *Muscina* is robust, and composed of eight distinct joints; ligula large, fleshy, and pilose; ocelli three; wings horizontally covering the body; alulæ none; hind tarsi often dilated in the males; body linear, very depressed. *Xylophagus*, *Actina*, *Beris*.

684. Chameleon flies (*Stratiomites*). Larva very elongate, attenuated at the anterior end, composed of twelve very distinct segments, besides the head; posterior extremity radiated;

inhabits the water. Pupa changes on the surface of the water, and continues floating: no material alteration in the form takes place. Imago with the antennæ eight-jointed; the basal and second joint are uniformly robust and hairy; the ligula is large, fleshy, and bilobed; ocelli three; wings narrow, reposing one on the other, and seldom wholly covering the body, which appears on each side; alulæ obsolete; body very flat, short, and wide. Flies in the sunshine, settling on leaves and flowers. *Stratiomys*, *Odontomyia*, *Oxycera*, *Nemotelus*, *Sargus*.

685. Golden-banded flies (*Chrysotoxites*.) Larva and pupa unknown; the former supposed to feed on the roots of corn, &c. Imago with the antennæ six-jointed; basal and second joint long and slender, third very long and more robust, the remaining three forming a slender and perfectly uniform seta, which arises from near the base of the third; ligula large, much dilated, bilobed; wings divaricating, covering the body; alulæ small or obsolete; body very stout, convex above. Inhabits woods, &c.; flies briskly in the sunshine. *Microdon*, *Chrysotoxum*.

686. Aphidivorous flies (*Syrphites*.) Larva flat, capable of great elongation anteriorly; inhabits the leaves of plants, feeding on aphites. Pupa changes adhering to the leaf. Imago with antennæ six-jointed; the first and second joints minute, the third stout and somewhat globose: the re-

mainder forming a seta attached to the third, near its base; ligula stout, dilated, bilobed: wings as in the *Chrysotoxites*; body glabrous, brown, banded with brighter colours. Flies in the sunshine, settling on flowers. *Ascia*, *Sphegina*, *Baccha*, *Eumerus*, *Psilota*, *Pipiza*, *Chelosia*, *Scæva*, *Syrphus*.

687. Sun-loving flies (*Helophilites*). Larva obese, generally furnished with a long tube at the posterior extremity, through which it breathes; inhabits mud, and all kinds of semi-liquid filth. Pupa changes in the air, attached to walls, &c. Imago with antennæ and mouth nearly as in the preceding order; ocelli three; body more linear; hind femora often incrassated and curved; colours brilliant. Flies in the sunshine, settling on flowers. *Helophilus*, *Xylota*, *Eristalis*.

688. Bee-flies (*Volucellites*). Larva less elongate, spined at the posterior extremity; inhabits the nests of humble bees, feeding on the wax. Pupa changes in the same situation. Imago with antennæ six-jointed; the portion forming the seta plumose; parts of the mouth nearly as in the two preceding orders: ocelli three; body obese, often very hirsute. Flies in the sunshine, settling on flowers. *Criorhina*, *Sericomyia*, *Volucella*.

689. Long-tongued flies (*Rhingiites*). Larva and pupa unknown. Imago with antennæ six-jointed, the third joint somewhat cordate; the portion forming the seta perfectly naked: ligula

slender, bifid, and capable of great elongation ; ocelli three ; body obese, naked, resembling in appearance the *Muscites*. Flies in the sunshine, settling on flowers. *Rhingia, Brachyopa*.

690. Flies (*Muscites*). Larva obese ; feeds on dung, putrid flesh and vegetables, bark and roots of trees, fungi, &c. Pupa changes in similar situations, oblong, perfectly uniform and rounded as though turned in a lathe. Imago with the apical seta of the antennæ triarticulate ; ligula elongate, dilated at the extremity, retractile ; alulæ of the wings distinct and conspicuous ; body hairy ; form obese ; colour black, brown, or grey, with metallic green and blue. *Phasia, Gymnosoma, Phania, Mitogramma, Gonia, Trixa, Tachina, Echionomyia, Melanophora, Leucostoma, Metopia, Exorista, Eriothrix, Ocypteryx, Dexia, Mesembrina, Sarcophaga, Musco, Anthomyia, Cænosia, Lispe*.

691. Dung-flies (*Scatophagites*). Larva inhabits dung, fungi, putrid substances, and the pith of plants. Pupa as in the *Muscites*. Imago with the apical seta of the antennæ obscurely triarticulate ; ligula elongate, slightly recurved, scarcely dilated, retractile ; alulæ of the wings very minute ; body very hairy ; form oblong ; colour yellow. *Scatophaga, Dryomyza, Sapromyza*.

692. Tetanocerites (*Tetanocerites*). Larva inhabits moist plants, fruits, putrid substances, also mud at the banks of ponds, rivers, and all wet places. Pupa as in the *Muscites*. Imago with

the apical seta of the antennæ exarticulate; ligula short and broad; alulæ of the wings wanting; wings narrow; form elongate, often very slender: glabrous or slightly hairy; colour black, black with yellow spots, brown or yellowish. *Ortalis*, *Sepsis*, *Lonchæa*, *Lauxania*, *Ulidia*, *Piophila*, *Psila*, *Calobata*, *Micropeza*, *Tetanocera*, *Loxocera*, *Heteromyza*, *Platycephala*, *Sciomyza*, *Lucina*, *Chryliza*, *Lissa*, *Platystoma*, *Sepedon*, *Dorycera*.

693. Variegated flies (*Tephritites*). Larva inhabits galls or excrescences on the bark and leaves of plants. Pupa as in the *Muscites*. Imago with the apical seta of the antennæ exarticulate; ligula large, fleshy, bilobed, and pilose; alulæ of the wings wanting; wings rather wider than in the preceding order, beautifully variegated, striped and spotted with different shades of black and brown; body glabrous, or with a slight pilosity, of moderate length and stoutness, and, in the females, furnished with a large exserted and conspicuous ovipositor. *Tephritis*.

694. Phytomyzites (*Phytomyzites*). Larva inhabits the interior of plants and fruits, and sometimes putrid substances. Pupa as in the *Muscites*. Imago with the apical seta of the antennæ exarticulate; ligula large, fleshy, clavate; alulæ of the wings wanting; wings as wide as in the preceding order; the body very delicate, often very slender, glabrous; colour black,

or black variegated with yellow. *Phytomyza*, *Chlorops*, *Meromyza*, *Agromyza*, *Discomyza*, *Gymnopa*, *Asteia*, *Drosophila*, *Ochthiphila*, *Opomyza*.

695. *Phorites* (*Phorites*). Larva inhabits the flowers and seeds of vegetables, and the larvæ of other insects. Pupa as in the *Muscites*. In the imago the apical seta of the antennæ is composed of four joints, the three basal ones being very short, the apical one very long; ligula very short; alulæ of the wings wanting; wings very wide, extending beyond the body, which is very small, acute at the extremity, and in colour inclining to black or yellow. *Phora*.

696. *Borborites* (*Borborites*). Larva inhabits putrid animal and vegetable substances. Pupa as in the *Muscites*. Imago with the apical portion of the antennæ perfectly simple and ex-articulate, sometimes orbicular; ligula large, membranous, and bilobed; alulæ of the wings wanting; wings very large and wide; body very small, and of a black colour. *Borborus*, *Ochthera*, *Dichæta*, *Ephydra*, *Notiphila*, *Homalura*, *Orygma*, *Cælopa*.

697. Bird-flies (*Carnites*). Larva and pupa unknown. Imago, with antennæ, consisting of a minute tubercle, situate in a fovea before the eyes; mandibles unknown; maxillæ short, their feelers apparently exarticulate, short, erect; ocelli none; fore wings short, not formed for flying; hind wings assuming the form of halteres, small, but

distinct. Inhabits the common starling. No British genus.

698. Horse-flies (*Hippoboscites*). Larva, apod and nearly spherical, is nourished and attains perfection in the ovary of its parent. Pupa changes in the same situation, and is produced in the state in which it undergoes the final change; its structure is nearly as in the *Muscites*, excepting an evident indentation at the end, which becomes the lower extremity of the future imago. Imago with triarticulate antennæ, the second joint most developed, and the third originating in a hollow or socket near the base of the second; mouth apparently adapted for suction, its component parts appear to be two mandibles, two maxillæ, and a sheath-like labium; tarsi five-jointed; occasionally with the fore wings developed, and the hind wings appearing as poisers. Infests quadrupeds and birds. *Hippobosca*, and the genera separated from it.

699. Bat-flies (*Nycteribiites*). Larva and pupa as in the preceding order. Imago with the antennæ obsolete; the mouth situated on the back of the prothorax, in which the head seems sunk; parts of the mouth obsolete or unascertained; wings entirely obsolete; legs, with the femora and tibiæ, each two-jointed, the tarsi five-jointed. Infests bats. *Nycteribia*.

CHAPTER IV.

ON THE CLASSIFICATION OF HYMENOPTERA.

700. THE metamorphosis in the third class, Hymenoptera, is necromorphous. The larva bears no resemblance to the imago ; it has small corneous mandibles, moving horizontally ; in seven orders, with six articulate, and twelve to sixteen prehensile, feet ; in the remaining orders, without feet. Pupa perfectly quiescent, having the organs of locomotion and manducation confined by a shell-like skin ; yet displaying all the limbs and organs, placed in order by the sides of the body, and detached from it, except at the usual points of connexion.

701. Imago with the mandibles strong, moving horizontally, and masticatory ; the other organs of the mouth fully developed ; three ocelli ; wings all developed, the fore exceeding the hind wings in size, membranaceous, and used in flying ; the mesothorax largely developed at the expense of the pro- and metathorax ; the pòdeon mostly restricted ; the tarsi five-jointed. Food very various.

702. Social ants (*Formicites*). Larva an inactive, obese, voracious maggot, residing entirely in the earth, and dependant for food on the care of the perfect insects. Pupa changes in a tough leathery cocoon; these cocoons are commonly known as "ants' eggs." Imago with the antennæ composed of about thirteen joints, often elbowed, slightly incrassated exteriorly; mandibles somewhat triangular, toothed; maxillæ obtuse; labium short, obtuse, its ligula not produced; maxillary and labial feelers fully developed and distinctly articulate; fore wings ample; hind wings small; lives underground in immense societies, consisting of three kinds of individuals, males, females, and abortive females. *Formica*, *Myrmica*.

703. Solitary ants (*Mutillites*). Larva and pupa unknown. Imago with antennæ composed of about thirteen joints, not elbowed, rather attenuated exteriorly; mandibles long, dentate at the apex; maxillæ obtuse; labium short, obtuse, its ligula not produced; maxillary and labial feelers fully developed and distinctly articulate; ocelli indistinct or wanting; wings possessed by the males only; females usually with the pro-, meso-, and metathorax equally developed; abortive females none. Inhabits sandy situations, is solitary. *Mutilla*, *Myrmosa*, *Methoca*.

704. Scholiites (*Scholiites*). Larva an elongate inactive maggot; inhabits a burrow or hole made in the sand by its parent, and feeds on the larvæ

or imagines of other insects which she has provided for its sustenance. Pupa changes in a silken cocoon spun by the larva at the bottom of its domicile. Imago with antennæ composed of about thirteen joints, very short, recurved, almost forming a ring; mandibles short, strong, dentate; maxillæ long, their feelers also long; labium longer than in the *Formicina*; its ligula trilobed; ocelli three, distinct; wings alike in both sexes; legs short, stout, spiny; female with a pungent sting. Solitary; inhabits sandy districts, settling occasionally on umbellate flowers; feeds on insects.
Tiphia.

705. Sapygites (*Sapygites*). Larva and pupa supposed to be as in the preceding order. Imago with antennæ composed of about thirteen joints, exteriorly incrassated, particularly in the males, longer and more robust than in the preceding order; mandibles, labium, &c. nearly as in the *Scholiites*; ocelli, three, distinct; wings alike in both sexes; legs short but slender, and without spines; female with a sting. Solitary; female inhabits walls, palings, and posts; male settles on umbellate flowers. *Sapyga*.

706. Sand-wasps (*Pompilites*). Larva and pupa as in *Scholiites*, the food of the former consisting frequently of spiders provided by its parent. Imago with antennæ composed of about thirteen joints, more long and slender than in the two preceding orders, attenuated exteriorly, and

mostly recurved ; mandibles long, and dentate at the apex ; labium short, with its ligula short and trilobed ; ocelli three, distinct ; wings alike in both sexes ; legs long, spiny ; female armed with a sting : inhabits all sunny banks in sandy situations, running with great activity, and continually vibrating its antennæ and wings ; feeds on insects.

Ceropales, Pompilus, Aporus.

707. *Sphexes (Sphecites)*. Larva and pupa as in *Scholiites*, the food differing only in the kind of insect provided. Imago with the antennæ composed of thirteen joints, short and recurved in both sexes ; mandibles very long, acute ; maxillæ very long, obtuse at the apex of their lacinia ; labium, with its ligula, elongate, bifid, and flexible ; ocelli three ; podeon elongate and very slender, whereas in the three preceding orders it is very short ; legs long. Inhabits sandy situations, flying heavily, but running with agility, and feeding on insects.
Ammophila.

708. *Larrites (Larrites)*. Larva and pupa as in the *Scholiites*, the former frequently feeding on *Cimicites*, provided for it by its parent. Imago with antennæ composed of thirteen joints, shorter in the females than the males, and often incrassated exteriorly ; mandibles less elongate than in the *Sphecites*, and bifid at the apex ; maxillæ very obtuse ; labium short, its ligula short, obtuse, and bilobed ; ocelli three ; podeon gene-

rally short and indistinct; legs moderately long. Inhabits sandy situations, occasionally umbellate flowers; is fond of settling on stones, leaves, &c.; feeds on insects. *Gorytes*, *Psen*, *Larra*, *Lyrops*, *Dinetus*, *Tripoxylon*, *Oxybelus*.

709. *Bembecites* (*Bembecites*). Larva and pupa as in the *Scholiites*, the food provided for the larva consisting of *Syrphina* and *Muscina*. Imago with antennæ thirteen-jointed, elbowed at the second, short, and of nearly uniform substance. No British genus.

710. False wasps (*Crabronites*). Larva and pupa as in the *Scholiites*, excepting that in this order many are frequently found in the same burrow. Imago with antennæ thirteen-jointed, short, and slightly incrassated externally; mandibles long, acute, and terminating in a single point; maxillæ obtuse; labium elongate, its ligula short, dilated, obtuse, and terminating in four lobes; ocelli three; head very large, square; legs short and stout, fore legs often patellated; body, with its greatest diameter, about the ninth segment, very glabrous, black, or black and yellow. Inhabits sandy banks, settling on leaves, stones, and umbellate flowers. *Cerceris*, *Philanthus*, *Crabro*, *Rhopalum*, *Stigmus*.

711. Wasps (*Vespites*). Larva an obese inactive maggot, inhabiting a cell provided by its parent, who supplies it with food, consisting of honey, pollen, &c. Pupa changes in a silken

cocoon, which the larva spins in its cell. Imago with antennæ composed of twelve joints in the female, thirteen in the male, slightly elbowed at the second joint; eyes somewhat reniform, the indented portions facing each other; ocelli three; upper wings folded longitudinally; pœdon slender, but short; eighth segment largest, both as to length and breadth. Live commonly in societies composed of three kinds of individuals, males, females, and abortive females; inhabit all climates and all situations. *Vespa*, *Eumenes*, *Odynerus*, *Epipone*.

712. *Masarites* (*Masarites*). Larva and pupa as in the *Vespites*. Imago with the antennæ composed of thirteen joints, of which the five terminal ones are closely united and form a club; wings as in the *Vespites*. No British genus.

713. Carpenter-bees (*Osmiites*). Larva an obese inactive maggot, deposited as an egg in the midst of a semi-fluid substance, composed of honey and pollen, collected by its parent, and stored in cells which are constructed for the purpose, mostly in timber which is going to decay. Imago with antennæ twelve-jointed in the female, thirteen-jointed in the male; they are slightly elbowed at the second joint, which is much longer than the others; the blade of the maxillæ is elongate and somewhat falcate; the maxillary feelers are minute, and generally composed of six indistinct joints; the labium

has its ligula variously developed ; it is always trilobed, but the central lobe, though always elongate, varies in the proportion it bears to the labial feelers ; the lateral lobes are very minute, short, and acute ; the labial feelers have the basal joint long, the second longer, the third and fourth short, somewhat conical, and forming an angle with the second ; the hind tibiæ are not formed for collecting pollen, but the body of the female is clothed beneath with a thick covering of hair, which serves for this use. *Anthidium*, *Megachile*, *Osmia*, *Heriades*, *Chelostoma*, *Ceratina*.

714. Flower-bees (*Panurgites*). Larva and pupa, as far as the British genera are concerned, unknown. Imago with antennæ twelve-jointed in the females, thirteen-jointed, and somewhat moniliform, in the males ; maxillæ with the blade lanceolate and of moderate length ; the maxillary feelers of equal length, and six-jointed ; labium with the ligula trilobed, the central lobe about equal to the true lip in length, the lateral lobes very short and acute ; the labial feelers with four joints, varying but slightly in length from each other ; the feelers exceed the ligula in length ; wings large, flight slow ; insect inactive ; body rather stout ; black, hairy. Inhabits in immense abundance the flowers of *Leontodon*, &c. in autumn. *Panurgus*.

715. Burrowing-bees (*Andrenites*). Larva inhabits a long tortuous burrow, formed by its parent

in the ground ; a small heap of earth, produced in excavating which, may almost invariably be observed at the mouth of the burrow ; feeds on a globular pellet of pollen, collected, moistened, and kneaded into a consistent mass, by the parent. Pupa changes in the earth. Imago with antennæ twelve-jointed in the female, thirteen-jointed, and of much greater length, in the male, elbowed, particularly in the females, at the second joint ; maxillæ with the blade somewhat obtuse, and no longer than the maxillary feeler, which is distinctly six-jointed ; labium, with the ligula very short, and quadrilobed, the lateral lobes usually equalling the internal ones in length ; hind tibiæ formed for collecting pollen. Inhabits sunny banks. Two kinds of individuals only. *Colletes*, *Dasypoda*, *Andrena*, *Halictus*, *Sphecodes*.

716. Mason-bees (*Melliturgites*). Larva inhabits nests constructed by its parent, either in the ground or against a bank or wall, and consumes pollen provided by its parent, and stored up at the time the egg is deposited. Pupa changes in a silken cocoon in the same situation. Imago with antennæ twelve-jointed in the female, thirteen-jointed in the male, elbowed at the second joint ; maxillæ with the blade lanceolate, elongate ; the maxillary feelers six-jointed and setaceous ; labium, with its ligula, trilobed, central lobe very long, obtuse, pubescent, lateral lobes not more than a fourth of its length, very acute ;

ligula, labial feelers, and blade of maxillæ, nearly corresponding in length; hind tibiæ formed for collecting pollen; body short, robust; wings small. Two kinds of individuals only. *Saropoda*, *Anthophora*.

717. Social-bees (*Apites*). Larva inhabits a cell usually hexagonal, and made of wax by the imago; it is fed with honey or a preparation of pollen by the imago. Pupa changes in a silken cocoon within the cell. Imago with the antennæ twelve-jointed in the female, thirteen-jointed in the male, elbowed at the second joint; labium with its ligula trilobed, the central lobe elongate, hirsute, extending beyond the labial feelers, the lateral lobes very short and obtuse; the labial feelers with the basal joint twice the length of the second, the third and fourth minute, short, and seated on the back of the second, rather before its extremity; blade of the maxillæ lanceolate, nearly as long as the labial feelers; maxillary feelers minute, apparently exarticulate; hind tibiæ with brushes for collecting farina. Live in large societies, composed of three kinds of individuals, males, females, and abortive females; the latter perform the laborious offices of the commonwealth. *Apis*, the honey-bee; *Bombus*, the humble-bee.

718. Cuckoo-bees (*Apathites*). Larva hatched from an egg, deposited by its parent in the nests of all the preceding bees at the time when their

own eggs are laid ; when it hatches, being stronger and larger than the rightful possessor of the cell, it consumes the food provided for its companion, and starves it to death ; and in those instances in which fresh supplies of food are daily provided, it continues to receive and appropriate them as its own. Pupa changes in the same situation, in a silken cocoon, spun by the larva. Imago has no apparatus either on the body or legs for collecting honey ; in other respects it resembles in structure each of the orders of *Apina* before described ; it enters their nest with perfect familiarity, and seems to be quite unsuspected of intrusion ; it collects no pollen or honey, never builds a nest of any kind, or takes any care of its young, but spends its time among flowers, or hovering about sand-banks in which other bees have fixed their habitations. *Apathus*, *Cælioxys*, *Melecta*, *Stelis*, *Epeolus*, *Nomada*.

719. Golden-wasps (*Chrysidites*). Larva and pupa, as in the *Apathites*, preys on the food destined for other insects, particularly of the two preceding stirpes. Imago with the antennæ thirteen-jointed in both sexes the second joint elongated, and forming a slight elbow ; maxillæ obtuse, dilated, their palpi five-jointed ; labium, with the ligula, obtuse, entire ; labial palpi three-jointed ; ocelli three ; body convex above, flattened or sometimes concave beneath, furnished, in the females, with a tubular retractile oviduct, but

without a sting; colours excessively brilliant, red, green, and blue, with a metallic gloss; abundant in fine sunshiny weather, settling on walls, sand-banks, posts, railings, &c. running with activity, and a vibrating motion of the antennæ. *Hedychrum*, *Elampus*, *Chrysis*, *Cleptes*.

720. Proctotrupites (*Proctotrupites*). Larva inhabits and feeds on the larvæ of other insects. Pupa changes in the same situations. Imago with antennæ composed of ten to fifteen joints, elongate in the males, shorter and often clavated in the females; mandibles somewhat elongate, their extremity generally bifid; maxillæ with the blade dilated, rounded, feelers generally three-jointed; labium, with its ligula seldom produced, entire, feelers minute, often exarticulate; ocelli three; fore wings with a single principal nervure; hind wings without nervures; oviduct of the female tubular and retractile, being simply an elongation of the body. Inhabits grass under trees, &c. during the greater part of the year. *Cinetus*, *Psilus*, *Proctotrupes*, *Platygaster*, *Teleas*, *Ceraphron*, *Sparasion*, *Dryinus*.

721. Egg parasites (*Mymarites*). Larva inhabits and feeds on the eggs of Lepidopterous insects. Pupa changes within the shell of the egg. Imago with the antennæ nine- to thirteen-jointed, sometimes twice the length of the body in the male, in the female elbowed and clavated; mandibles at the apex tridentate; the other organs

of the mouth are obsolete or undiscovered ; fore wings pedunculated, with one short basal nervure, strongly ciliated ; hind wings the same, often a mere seta ; legs long : podoon elongate, slender ; ovipositor very slender, concealed beneath the body in a groove. Inhabits grass under trees. *Ooctonus*, *Litus*, *Anagrus*, *Polynema*, *Mymar*, *Eustochus*.

722. Burnished parasites (*Chalcites*). Larva inhabits and devours other insects in all stages, particularly the larvæ of *Lepidoptera* and *Diptera*. Pupa usually changes within the skin of its victim. Imago with the antennæ generally composed of thirteen joints, the second long, forming an elbow, the remaining joints generally incrassated towards the apex ; mandibles obtuse ; maxillæ, with the blade rather produced, but obtuse ; maxillary palpi four-jointed ; labium, with its ligula always produced, but short and entire ; labial palpi three jointed ; ocelli three ; head very large, square ; fore wings with a single nervure, often ciliated ; hind with none ; body often short and depressed in the males, more elongate and pointed in the females ; oviduct of the female slender, mostly concealed ; colour mostly brilliant. *Perilampus*, *Leucospis*, *Smiera*, *Chalcis*, *Callimome*, *Pteromalus*, *Encyrtus*, *Eulophus*, *Spalangia*, *Eucharis*.

723. Oak-gall flies (*Cynipites*). Larva inhabits and causes the excrescences we observe on

the trunks, twigs, leaves, &c. of trees, particularly the oak, and commonly known as "galls," feeding on the sap or substance. Pupa changes in the cavity made by the larva. Imago with the antennæ composed of thirteen to fifteen joints, increasing in size exteriorly, but never clavated; mandibles obtuse; maxillæ dilated, obtuse, feelers often five-jointed; labium short, with its ligula produced, generally as long as the feelers, entire; feelers mostly three-jointed; wings with many nervures; head rather small, somewhat retiring; mesothorax large and convex; podeon short, very slender; body compressed; deca-ton in the female very large; ovipositor curved, or spirally convoluted beneath the body. Beaten out of trees, and off grass, in the summer. *Cynips*, *Figites*, *Ibalia*, *Anacharis*.

724. *Evaniites* (*Evaniites*). Larva inhabits the larvæ of *Sphécina*, and occasionally of *Blattina*. Pupa changes within the cocoon spun by the larva of the former of these stirpes. Imago with antennæ thirteen-jointed, of uniform thickness, and very straight; mandibles short, stout, acute, and bifid; maxillæ dilated and obtuse, feelers six-jointed; labium, with the ligula very short, quadrilobed, the lateral lobes very minute, feelers long, often robust, four-jointed; wings with many nervures; podeon slender. Found in summer, flying over flowers and about sand-banks, in which the *Sphécina* have formed their burrows

and provided for their young. *Evania*, *Brachygaster*, *Fænus*.

725. Ichneumons of the second line (*Bracconites*). Larva more obese, without distinct markings and divisions; feeds, often in company, on the larvæ of *Lepidoptera*, and other insects. Pupa changes within the skin of the Lepidopterous larva, or in small silken cocoons, attached to the hair or body of its prey, &c. Imago with the antennæ ten- to twenty-jointed; mandibles short, generally bifid; maxillæ obtuse, feelers six-jointed, elongate; labium short; ligula obtuse and entire; feelers four-jointed; ocelli three; fore wings with fewer nervures than the following order; hind wings with still less; pœdeon slender and short; oviduct with two protecting appendages. Inhabits grass, &c. *Bassus*, *Rogas*, *Alysia*, *Bracon*, *Microgaster*, *Microdus*, *Sigalphus*, *Aphidius*.

726. Ichneumons (*Ichneumonites*). Larva elongate, with the divisions of the segments clearly defined; solitary; inhabits and devours the fleshy parts of other insects. Pupa changes sometimes within the shell of the pupa of the Lepidopterous insects; sometimes in the ground, in a tough, close, leathery cocoon, spun by the larva. Imago with long filiform antennæ composed of about forty joints; mandibles short, stout, acute, and bifid; maxillæ dilated and obtuse, their feelers six-jointed, and often very long; labium short, its

ligula short and bilobed, its feelers generally four-jointed; ocelli three; fore and hind wings with numerous nervures; podcon always slender, seldom or never elongate; oviduct generally defended by a setaceous appendage on each side, thus appearing to be triple: varies greatly in length. Inhabits vegetables of all kinds throughout the summer. *Ichneumon*, *Anomalon*, *Ophion*, *Banchus*, *Peltastes*, *Alomya*, *Cryptus*, *Pimpla*, *Xylonomus*.

727. *Sirecites* (*Sirecites*). Larva cylindrical, with six rudimental articulate legs; head corneous; paratelum incrassated; inhabits timber. Pupa changes in the same situation. Imago with antennæ filiform, attenuated exteriorly, composed of fifteen to thirty joints, the number varying in different individuals of the same sex and species; mandibles strong, trifold; maxillæ rather elongate, soft, flexible, obtuse, their feelers very minute, exarticulate; labium somewhat triangular; ligula short, entire, dilated; feelers three-jointed, the terminal joint long and incrassated; ocelli three; wings ample with many strong nervures; prothorax fully developed, broader than the head, its anterior and posterior margins concave; the following segments fully and equally developed; ovipositor exerted, composed of three setæ. Inhabits fir plantations. *Sirex*.

728. *Xyphidriites* (*Xyphidriites*). Larva perfectly without feet. Inhabits and lives on the

dead or dying wood of various trees. Pupa changes in the same situations. Imago with antennæ composed of seventeen or eighteen joints, gradually attenuated towards the apex; mandibles small, with four distinct teeth; maxillæ short, obtuse, their feelers biarticulate; labium short; ligula minute, entire; feelers four-jointed; ocelli three; head orbicular, large; prothorax very long, slender, and neck-like; the remaining segments of uniform size; the oviduct of the female exserted, covered above by a sheath-like appendage. Inhabits posts, decayed willows, &c. flying in the sunshine. *Xyphidria*.

729. *Xyelites* (*Xyelites*). Larva perfectly without feet. Feeds in the wood of fir-trees, making channels, as in the two preceding orders. Pupa changes in the same situations. Imago with antennæ twelve-jointed, the basal and second joint short, the third very long, and the nine following very short, together scarcely equalling the third in length,肘ed twice, at each end of the long joint; mandibles moderately long, acute, and dentate internally; maxillæ with the blade small, obtuse, the galea biarticulate, the feelers very long, and four-jointed; labium short, ligula hitherto undiscovered, feelers four-jointed; ocelli three; wings very ample; legs short; prothorax not developed superiorly, the mesothorax and head meeting above it; pòdeon as wide as the other segments; oviduct ensiform, exserted,

enclosed between two appendages. Inhabits fir-trees, occasionally settling on umbelliferous plants.
Xyela.

730. *Oryssites* (*Oryssites*). Larva and pupa unknown. Imago with antennæ eleven-jointed in the male, ten-jointed in the female, short, rather incrassated exteriorly, the joints of various proportions and forms; mandibles dilated, rounded, pubescent; maxillæ, with the blade, obtuse, rounded; the galea rather elongate, narrow, and truncate at the apex; feelers long, pubescent, and five-jointed; labium short, with the ligula small, rounded, and entire, and the feelers rather short and three-jointed; ocelli three; fore and hind wings moderately large, with numerous nervures; legs short; prothorax with very little development superiorly; pòdeon as wide as the other segments; ovipositor spirally convoluted beneath the body. Inhabits fir and horn-beam trees.

Oryssus.

731. Common saw-flies (*Allantites*). Larva cylindrical, of uniform substance, with six articulated and twelve or fourteen membranaceous feet. Inhabits vegetables, feeding upon their leaves in the manner of *Lepidopterous* larvæ. Pupa sometimes changes in a cocoon, fixed in a curled leaf of the plant the larva feeds on, but most commonly on or in the ground. Imago with antennæ nine-jointed, of uniform substance, or attenuated towards the apex; mandibles short, strong, very acute at the

apex, and having one internal tooth; maxillæ, with the blade acute, the galea obtuse and exarticulate, the feelers long and six-jointed; labium short, with the ligula distinctly trilobed; wings ample; podcon equally developed with the other segments; oviduct with teeth like a saw. Abundant in the spring and summer in woods, &c. on leaves and flowers. *Nematus*, *Cladius*, *Cræsus*, *Emphytus*, *Dolerus*, *Dosytheus*, *Allantus*, *Fenusa*, *Selandria*, *Athalia*.

732. *Hylotomites* (*Hylotomites*). Larva cylindrical, rather attenuated towards the extremities, with six articulated and fourteen membranaceous legs. Inhabits and feeds on the leaves of vegetables. Pupa changes mostly on the surface of the ground. Imago with the antennæ three-jointed; the basal and second joints very short, the third very long, ciliated, and often double, or having two shafts in the manner of a fork; mandibles corneous, acute, with a small internal tooth; maxillæ with the blade acute, the galea robust and obtuse, the feeler long and six-jointed; labium short, with the ligula small, but distinctly trilobed; feelers four-jointed; ocelli three; body, with the segments and oviduct, as in the *Allantites*. Settles and feeds on umbellate flowers. *Schizocerus*, *Hylotoma*.

733. Club-horned saw-flies (*Tenthredinites*). Larva mostly chagreened, cylindrical, with six articulate and twelve prehensile legs. Feeds on the leaves of trees. Pupa changes in a case

composed of a glutinous matter, which becomes very hard when exposed to the air; the case is attached to a slender twig of the plant on which the larva feeds; in this case the larva remains unchanged during the months of autumn, winter, and spring. Imago with antennæ seven-jointed, of which the third joint is always elongate, and the apical ones always form a club; the mandibles are longer than in the preceding order, acute at the apex, and internally bidentate; maxillæ, with the lacinia, obtuse and hirsute, the galea rather obtuse and distinctly articulate, and the feelers long and six-jointed; labium short, with the ligula distinctly trilobed, the feelers four-jointed; ocelli three; segments of the body fully developed; oviduct as in the *Allantites*. Inhabits flowers and leaves; flies in the sunshine. *Abia*, *Zaræa*, *Cimbex*, *Trichiosoma*, *Clavellaria*.

734. *Lydites* (*Lydites*). Larva smooth, cylindrical, with six short, articulate, and no prehensile legs. Feeds on the leaves of trees, inhabiting a web of its own making. Pupa changes in a silken cocoon on the stem of the trees it inhabits, or on the ground. Imago with the antennæ composed of seventeen to thirty joints, filiform, and attenuated exteriorly; mandibles long, acute at the apex, and having one tooth internally; maxillæ, with the blade and galea, obtuse, the feeler long and six-jointed; labium short, ligula more produced, trilobed; ocelli three; head large,

orbicular; wings ample, with numerous nervures; legs short; podeon fully developed; body short and robust. Inhabits woods, flying in the sun, settling on leaves, and occasionally, but rarely, on flowers. *Tarpa*, *Lyda*, *Lophyrus*? which principally differs in its pectinated antennæ.

735. *Cephites* (*Cephites*). Larva elongate, with its feet obsolete or rudimental. Inhabits and feeds on the stalks of corn and the buds of fruit-trees. Pupa changes within the stalk. Imago with antennæ twenty-jointed, long, fili-form, slightly incrassated externally; mandibles short, broad, trifid; maxillæ with the blade distinct and acute, the galea elongate, and separated from the maxilla by a distinct line, the feeler long and six-jointed; labium with its four parts perfectly developed, the feeler-bearer elongate, and notched at the apex, the ligula produced and trilobed, and the feeler four-jointed; ocelli three; head rather square, broader than the following segments; prothorax fully developed, cylindrical, quite detached from the mesothorax; podeon fully developed, divided on the back longitudinally; body elongate; legs elongate; flight easy and graceful in the sunshine. Settles in abundance on composite flowers by the roadside, and in meadows on *Ranunculi*. *Cephus*.

CHAPTER V.

CLASSIFICATION OF COLEOPTERA.

736. THE metamorphosis of coleoptera, is necromorphous. Larva, with corneous mandibles moving horizontally; a pair of articulate feet, generally on the second, third, and fourth segments; no other feet, unless a prehensile caudal appendage occasionally present can be so denominated. Food very various. Pupa of nearly uniform appearance.

737. Imago with the parts of the mouth fully developed; the mandibles moving horizontally, and being employed in mastication. Wings fully developed; fore wings hard, crustaceous, not used in flying, when closed meeting with parallel edges, and completely covering the hind wings, to protect which appears their only office; hind wings generally much longer than the body, folded longitudinally and transversely beneath the fore wings. Prothorax very large; mesothorax small; metathorax large. Food various.

738. Slow-legged beetles (*Blapsites*). Larva elongate, cylindrical, with six articulate and one caudal leg. Lives in the dark, feeding on decayed animal and vegetable substances. Pupa changes in the same situations. Imago with moniliform antennæ, the third joint being the longest; mandibles small but strong, bifid at the apex; maxillæ with a single tooth internally; wings, particularly the hind pair, frequently wanting. Inhabits cellars, out-houses, decayed trees, shunning the light, and moving by night with a slow, awkward, and disgusting gait; of uniform dark brown or black colour. *Blaps*, *Tenebrio*.

739. Helopites (*Helopites*). Larva very elongate, cylindrical, frequently with two hooks on the telum. Inhabits and feeds on decayed wood. Pupa changes in the same situations. Imago with filiform antennæ; mandibles sometimes bifid, sometimes terminating in a single point; maxillæ without the internal tooth; fore wings generally soft and flexible, hind wings generally perfect, adapted for flight. Inhabits decayed woods, flowers, &c. *Helops*, *Cistela*, *Melandrya*, *Conopalpus*, *Hypulus*, *Nothus*.

740. Mordellites (*Mordellites*). Larva less elongate, soft, and more fleshy; legs less distinct. Inhabit and feed on decaying wood, flowers, and sometimes parasitical in the nests of wasps. Pupa changes in the same situations. Imago with

pectinated antennæ, particularly the males; head somewhat heart-shaped, and united vertically to the prothorax; fore wings flexible, wide at the base, narrow at the apex; hind wings mostly without the longitudinal fold. Inhabits flowers; diurnal, flies and runs with rapidity and ease. *Orchesia*, *Anaspis*, *Mordella*, *Ripiphorus*.

741. Soldier-beetles (*Pyrochroites*). Larva more depressed; head as wide as the prothorax; paratelum the largest segment; telum corneous, and produced into two spines. Inhabits and feeds on decaying wood. Pupa changes in the same situations, or in the ground. Imago, with long pectinated antennæ; head exserted, triangular, and porrected horizontally, narrower than the prothorax; fore wings soft, flexible, brilliant red; diurnal, flying readily in the sunshine. *Pyrochroa*.

742. Blister-beetles, &c. (*Cantharites*). Larva and pupa unknown, supposed in some instances to be parasitical. Imago with moniliform antennæ incrassated about the middle; head larger than the prothorax, to which it is attached vertically; fore wings short, their margins crossing each other, flexible; hind wings often wanting; tarsi with the terminal claws double. *Meloë*, *Cantharis*.

743. Flower-beetles (*Anthicites*). Larva and pupa in decayed wood. Imago with filiform antennæ sometimes slightly serrated; elongate

linear body ; soft fore wings. Inhabits flowers, flying readily and in the day-time. *Notoxus*, *Anthicus*, *Xylophilus*.

744. Wood-boring beetles (*Ptinites*). Larva, with the articulate feet distinct, incrassated in the middle, narrower towards the tail, often covered with bristles. Commonly inhabits dry wood, through which it bores in all directions, reducing it to a powder. Pupa changes in the galleries made by the larva. Imago with long antennæ generally filiform, but in some of the males highly pectinated ; the mandibles strong and toothed ; the head retractile within the prothorax ; the prothorax more or less spherical ; the fore wings completely covering the body, and having often an inflated appearance. Inhabits the habitations of the larva, and occasionally flowers. *Ptilinus*, *Ptinus*, *Anobium*, *Mezium*, *Gibbium*.

745. Ant-beetles (*Clerites*). Larva in structure like the preceding order, but more elongate, and less commonly hairy. Feeds on the larvæ of the preceding order, and occasionally of some *Hymenoptera*. Imago with the antennæ incrassated externally ; the mandibles bifid ; the maxillæ obtuse ; the prothorax is long, slender, cylindrical, of less circumference than the head or body. *Necrobia*, *Clerus*, *Opilus*, *Thanasimus*, *Tillus*.

746. Melyrites (*Melyrites*). Larva elongate, soft, pubescent, gradually incrassated posteriorly ;

telum corneous, produced into two spines. Inhabits and feeds on decaying wood. Pupa changes in the same situations. Imago, with the antennæ filiform, tapering to the extremity; mandibles elongate, toothed, bifid at the apex; head nearly corresponding in width with the prothorax, but rather less; prothorax with the margins often dilated; when touched, a red fleshy substance is protruded from several parts of the body and again withdrawn. Inhabits flowers; flies readily and in the sunshine. *Dasytes*, *Malachius*.

747. Glow-worms (*Lampyrites*). Larva composed of thirteen very distinct segments, the divisions between which are deeply marked, giving the back a serrated appearance; legs very perfect, the caudal leg also present. Inhabits old hedges among decayed sticks, found also under stones; feeds on minute snails, &c. Pupa changes under ground. Imago with the antennæ filiform, moniliform, or pectinated; the mandibles small, soft, and somewhat imperfect; the prothorax flattened, dilated at the margins; the fore wings flexible, leathery; females sometimes without wings; frequently emitting from the two last segments a bright phosphoric light. *Lampyris*, *Drilus*, *Telephorus*, *Lycus*.

748. Soft winged beetles (*Cebrionites*). Larva and pupa unknown. Imago with the antennæ very simple, filiform; mandibles imperfect, ter-

minating in a single point; prothorax semicircular, the convex, being the anterior margin, completely concealing the head; fore wings and whole body soft and flexible, as though immature; more round and compact in shape than the preceding orders. Inhabits the leaves and flowers of plants in summer. *Dascillus*, *Elodes*, *Scirtes*.

749. Click-beetles (*Elaterites*). Larva elongate, cylindrical, with six articulate and one caudal leg; slothful. Feeds on the roots of wheat, potatoes, &c., also occasionally in decaying timber; is very destructive to crops, and known to farmers as the WIRE-WORM. Pupa mostly changes in the ground. Imago with moniliform antennæ, not unfrequently serrated or pectinated in the males; mandibles bifid at the extremity; head received into the prothorax; prothorax with a projecting spine beneath; metathorax with a cavity for the reception of the spine. Inhabits flowers, &c. *Elater*, *Campylus*.

750. Burn-cows (*Buprestites*). Larva very elongate, cylindrical, with six articulate and one caudal prehensile leg. Feeds on timber. Pupa changes in the same situation. Imago with serrated or pectinated antennæ; mandibles short, strong, and bifid; head more than two-thirds received into the prothorax; prothorax beneath produced posteriorly into a spine; but there being no corresponding cavity in the mesothorax, the

insect has not, when placed on its back, the power of leaping possessed by the *Elaterites*. These insects are diurnal; they possess the most gorgeous metallic colours; they run and fly with ease and rapidity. *Buprestis*.

751. Day chafers (*Cetoniites*). Larva, with six elongate, weak, articulate legs, and the posterior extremity of the body incrassated, soft, and recurved under the fore part. Inhabits and feeds on decaying wood. Pupa changes in the same situations, or in the ground. Imago, with antennæ composed of ten joints, of which the three or four terminal ones are produced laterally, and form a club; labrum membranaceous, mostly concealed by the clypeus; mandibles and maxillæ pubescent and membranaceous; colours various and brilliant; form generally flattened above; diurnal, flies with ease and rapidity. Feeds on the farina or honey of flowers. *Cetonia*, *Trichius*.

752. Cock-chafers (*Melolonthites*). Larva resembles that of the preceding order. Inhabits the earth, feeding on the roots of vegetables. Pupa changes in the ground. Imago with antennæ composed of nine or ten joints, the six or seven terminal ones produced laterally, and forming a flabellated club; labrum more corneous than in the preceding order, and not entirely concealed by the clypeus; mandibles corneous and masticatory; colour less brilliant; form generally convex above; flight easy, not rapid; mostly nocturnal. Feeds

on the leaves of vegetables. *Hoplia*, *Anomala*, *Melolontha*, *Amphimalla*, *Omaloplia*, *Phyllopertha*, *Serica*.

753. Sand-chafers (*Trogites*). Larva resembles that of the two preceding orders. Feeds on decaying animal and vegetable matter found in sand, which it inhabits. Pupa changes in the sand. Imago with antennæ composed of nine or ten joints, the three or four terminal ones forming a small round club; labrum and mandibles concealed and membranaceous; colour black; form oval and very convex above. Inhabits sand, particularly by the sea-shore; seldom flies. *Trox*, *Ægialia*, *Psammodius*.

754. Dung-chafers (*Scarabæites*). Larva resembles the preceding. Inhabits and feeds on the excrement of animals. Pupa changes in the ground. Imago with antennæ composed of nine or ten joints, the terminal one forming a compressed club; labrum generally concealed by the clypeus; mandibles sometimes corneous, sometimes membranaceous; colour brown, black, or metallic-tinted black; form oval, convex above. Inhabits and feeds as in the larva state; flight easy, rapid, mostly nocturnal. *Aphodius*, *Geotrupes*, *Bolboceras*, *Onthophagus*, *Copris*.

755. Stag-beetles (*Lucanites*). Larva resembles the preceding; feeding on decayed wood. Pupa changes in the same situations. Imago with ten-jointed antennæ, the basal joint very long, and

the others bending forward from it at a right angle, forming an elbow, the three apical joints forming a club; labrum concealed or obsolete; mandibles very long, strong, and toothed; maxillæ weak and pilose. Flight nocturnal. Feeds on the sap of plants. *Sinodendron, Lucanus, Platycerus.*

756. Mimick-beetles (*Histerites*). Larva rather more elongate than that of the *Lucanites*, in other respects nearly similar in formation. Inhabits and feeds on putrid substances. Pupa mostly changes in the ground. Imago with clavate antennæ; strong, corneous, and projecting mandibles; head retractile within the prothorax; fore wings square and very short; legs retractile; form a long square; covering excessively hard, highly polished. Inhabits putrid substances; mimicks death when disturbed; flies occasionally in the sunshine. *Hister, Dendrophilus, Onthophilus, Abræus.*

757. Pill-beetles (*Byrrhites*). Larva as in the *Histerites*, but somewhat pilose. Feeds on the roots of vegetables and decaying wood. Pupa mostly changes in the earth. Imago with monili-form antennæ incrassated towards the extremity, but not clubbed; mandibles corneous but not projecting; form nearly globular; covering downy, not polished; head and legs retractile. Inhabits vegetables, mimicking death if touched; crawls in the day; flies but seldom. *Nosodendron, Byrrhus, Aspidiphorus, Simplicaria.*

758. *Dermestites* (*Dermestites*). Larva somewhat shuttle-shaped, very pilose. Inhabits and feeds on decayed and dried animal substances. Pupa changes in the same substances. Imago with short clavated antennæ; mandibles short, strong, and toothed; form oval; head and legs retractile, but less perfectly so than in the two preceding orders. Inhabits dead animals; when shaken out or disturbed, mimicking death: flight principally nocturnal. *Attagenus*, *Dermestes*, *Megatoma*.

759. *Ipsites* (*Ipsites*). Larva more elongate, slightly pubescent. Inhabits and feeds on the bark of trees or fungi. Pupa changes in the bark. Imago with clavated antennæ, the club not abrupt, but generally formed by a gradual incrassation of the antennæ externally; prothorax nearly square, generally longer than wide; form elongate: flight only occasional, mostly diurnal. *Lyctus*, *Sylvanus*, *Rhizophagus*, *Nemosoma*, *Ips*, *Tetratoma*, *Triplax*, *Mycetophagus*, *Antherophagus*.

760. *Nitidulites* (*Nitidulites*). Larva pubescent, more active than the preceding. Generally inhabits and feeds on decayed animal substances. Pupa changes in the same situations or in the earth. Imago with clavated antennæ, the club abrupt and well defined, usually composed of three joints: active; flies readily. Inhabits, in great quantities, decayed animal substances, particularly

bones, and also strongly-scented flowers. *Cathe-
retes*, *Meligethes*, *Strongylus*, *Nitidula*, *Thy-
malus*.

761. Carrion-beetles (*Silphites*). Larva gla-
brous, depressed, attenuated posteriorly ; very
active. Inhabits putrefying animal substances.
Pupa changes mostly in the earth. Imago with
antennæ clavated or moniliform, externally increas-
ed ; mandibles strong, pointed, and prominent ;
head capable of being bent vertically, and con-
cealed by the prothorax, but not withdrawn into
it ; prothorax as wide as the body. Inhabits
putrid animal substances, as dead birds, mice,
rats, &c. which it buries in the earth as receptacles
for its eggs ; flight diurnal and nocturnal ; scent
very offensive. *Silpha*, *Necrophorus*, *Choleva*,
Catops, *Pltomaphagus*, *Scaphidium*, *Scaphiosoma*.

762. Globe-beetles (*Spheridiites*). Larva in-
habits and feeds on the dung of horses and cows.
Pupa changes in the same situations. Imago
with antennæ clavated ; club distinct and abrupt ;
form nearly spherical or oval. Inhabits and feeds
as in the larva state ; runs and flies with rapidity
in the sunshine. *Sphæridium*, *Cercyon*.

763. Herbivorous water-beetles (*Hydrophilites*).
Larva elongate, attenuated posteriorly, active, car-
nivorous, aquatic ; head large, with long curved
mandibles. Pupa changes in the earth or under
dung. Imago with clavated antennæ ; mandibles
strong and obtusely toothed ; maxillary feelers

very strong, and used in the water as antennæ; the form oval, the sides and back very convex, the surface glabrous. Inhabits water, swimming with ease, the feet being moved alternately; female covers her eggs with silk, forming a kind of cocoon, which she carries about with her in the manner of some spiders. Feeds on the decaying leaves of water-plants. *Spercheus*, *Hydrophilus*, *Hydroüs*, *Hydrobius*, *Berosus*.

764. Diving-bell beetles (*Helophorites*). Larva less clongate; sluggish; margins of the segments fringed with hair. Inhabits duckweed, and other plants on the surface and banks of ponds, also the surface of stones, mud, &c. Pupa changes sometimes in the same situations, but mostly in the earth. Imago with antennæ more or less clavated, short, and generally concealed; the maxillary feelers being employed as antennæ; form clongate. Inhabits the banks of ponds and rivers, among aquatic plants, on which it feeds; enclosed in a bubble of air, it crawls on water-plants and on the surface of water, with the back downwards, but does not swim. *Hydræna*, *Helophorus*, *Hydrochus*, *Georyssus*, *Elmis*, *Parnus*, *Heterocerus*.

765. Water-fleas (*Gyrinites*). Larva with strong arcuate mandibles; a long fleshy process, fringed with hair, rising from both sides of each segment; carnivorous, aquatic, natatory. Pupa changes at the edge of ponds. Imago with

short clavated antennæ; mandibles short and obtuse, but strong; maxillæ somewhat obtuse; galea palpiform, exarticulate; fore legs long, middle and hind legs short and incrassated; carnivorous. Inhabits water, performing in the sunshine its beautiful and social gyrations on the surface. *Gyrinus*.

766. Carnivorous water-beetles (*Dytiscites*). Larva with strong arcuate mandibles, perforated at the extremity for suction; carnivorous, aquatic, natatory. Pupa changes in the earth, at the margins of ponds, among roots of trees and grass. Imago with filiform antennæ; mandibles short and strong; maxillæ arcuate and very acute; galea palpiform and articulate; the fore tarsi patellated in the males; the middle and hind legs flattened and ciliated; form oval. Inhabits water, feeding on aquatic animals; swims with great ease and swiftness, moving the corresponding legs simultaneously. *Acilius*, *Dytiscus*, *Colymbetes*, *Noterus*, *Hydroporus*.

767. Ground-beetles (*Carabites*). Larva with strong arcuate mandibles; active and carnivorous. Inhabits roots of grass, rubbish-heaps, decaying vegetables, moss, under stones, &c. in which situations it pursues and seizes its prey. Pupa changes in the earth. Imago with moniliform antennæ; mandibles moderately short, very strong; maxillæ terminate in a blade, sometimes acute, but never articulated; galea articulate and palpiform.

Carnivorous; chiefly nocturnal, and during the day found principally under stones and timber, at the roots of grass, in the sand of gravel-pits, &c.; sometimes flies, but not to avoid pursuit. *Ela-phrus*, *Bembidium*, *Harpalus*, *Carabus*, *Dyschirius*, *Brachinus*, *Dromius*, *Odocantha*, *Drypta*.

768. Tiger-beetles (*Cicindelites*). Larva with strong arcuate mandibles, and frequently with two remarkable recurved hooks on its back; it is carnivorous, and lies in wait for its prey in holes or dens, which it constructs in loose earth or sand, in sunny places. Pupa changes in the holes of the larva. Imago with strong, long, arcuate, and deeply-toothed mandibles, which cross each other at about half their length; blade of the maxillæ acute and articulated; galea palpiform and articulated; legs very long and slender; diurnal, carnivorous, of light and elegant form, and brilliant colours. Runs with amazing activity; flies to avoid pursuit. *Cicindela*.

769. Devil's coach-horses (*Staphilinites*). Larva with strong mandibles; active, mostly carnivorous. Found under stones, at the roots of grass, in rubbish-heaps, &c. Pupa changes in the same situations, and is remarkable for the compactness with which the limbs are attached, giving it the appearance of the amorphous classe. Imago with moniliform antennæ; strong and acute mandibles; obtuse maxillæ; rounded and never palpiform galea. These beetles are distinguished at

once from all others by their square, short fore wings, naked body, elongate form, and disgusting manner of turning up the tail like a scorpion. Inhabits and devours all putrefying substances, also living insects. *Staphylinus*.

770. Short-winged moss-beetles (*Pselaphites*). Larva and pupa unknown. Imago with acute dentate mandibles; obtuse maxillæ; rounded, exarticulate, though somewhat palpiform galea; maxillary feelers clavated, immensely developed, often equalling the antennæ in size; antennæ with ten or eleven joints, the last joint incrassated, forming a club; fore wings quadrate and abbreviated; hind wings usually wanting; tarsi two-jointed. Very minute; slow in its movements. Inhabits moss and the roots of grass, feeding on the *Acari* which occur in those situations. *Pselaphus*.

771. Long-winged moss-beetles (*Scydmaenites*). Larva and pupa unknown. Imago with antennæ eleven-jointed, moniliform, incrassated exteriorly; the basal joint rather long, the apical one ovate, which, with the two preceding, is incrassated; maxillary feelers very large, the third joint stout and conical, the fourth and terminal one small, acute; fore wings completely cover the body; the tarsi five-jointed. Inhabits moss, and under planks near cucumber frames; feed on *Acari*. *Scydmaenus*, *Eutheia*.

772. Fungus-beetles (*Endomycites*). Larva with six distinct articulate legs; head small;

middle of the body stout, gradually attenuated to the tail. Principally inhabits and feeds on the interior of fungi. Pupa changes in the same situations. Imago with moniliform antennæ, incrassated externally; acute mandibles; tarsi three-jointed; form very convex, oval, glabrous. Inhabits fungi. *Lycoperdina*, *Endomychus*.

773. Lady-birds (*Coccinellites*). Larva in structure like that of the preceding order, but rather more elongate and active. Inhabits the leaves of vegetables, feeding on the *Aphites* which suck their sap. Pupa attaches itself by the tail to a leaf, and changes in that position. Imago with short and rather clavate antennæ; acute mandibles; tarsi three-jointed; form very convex above, nearly hemispherical. Inhabits vegetables, feeding on the *Aphites* which infest them. *Cacicula*, *Chilochorus*, *Coccinella*.

774. Tortoise-beetles (*Cassidites*). Larva more obese and obtuse, spiny or radiated round the margin; the tail furnished with a remarkable forked appendage, on which the excrement accumulates, forming a kind of umbrella, which protects it in some degree from observation. Inhabits and feeds on vegetables. Pupa changes in the same situations. Imago with moniliform antennæ; mandibles and maxillæ obtuse and minute; galea palpiiform, exarticulate; head completely hidden by the prothorax, which, together with the fore wings, form a complete covering, like the carapax

of a tortoise; tarsi four-jointed; form nearly hemispherical. Inhabits vegetables, on which it feeds. *Cassida*.

775. Bloody-nose beetles (*Chrysomelites*). Larva still more obese, inactive; legs short. Feeds on the leaves of vegetables. Pupa sometimes attaches itself, and changes in the same situations, and sometimes in the earth. Imago with moniliform antennæ, inserted far from each other; mandibles rather obtuse; maxillæ obtuse; galea palpiform, exarticulate; head nearly concealed by the prothorax; tarsi four-jointed; legs not formed for leaping; form very globose, inactive; flies seldom. Inhabits vegetables, on the leaves of which it feeds. When touched frequently emits a red fluid from the mouth. *Cryptocephalus*, *Clythra*, *Chrysomela*.

776. Flea-beetles (*Alticites*). Larva and pupa nearly as in the preceding order; the former rather less obese. Imago with much longer and more filiform antennæ, and inserted nearer together; more acute mandibles; maxillæ obtuse; galea palpiform and articulate; hind legs incrassated, formed for leaping; form less globose. Inhabits and feeds on vegetables; its size is little larger than that of a flea, an insect which it emulates in the activity of its leaps; it is excessively injurious to crops, sometimes causing a total failure of turnips, rape, &c. *Altica*.

777. Galerucites (*Galerucites*). Larva and

pupa nearly as in the *Chrysomelites*. Imago with long filiform antennæ, inserted much nearer to each other than in either of the two preceding orders; mandibles acute; maxillæ obtuse, with a distinctly articulate palpiform galea; legs of similar structure, not formed for leaping; form more elongate. Inhabits and feeds on vegetables; flies more readily than the two preceding orders, but does not leap. *Galeruca*, *Adimonia*, *Auchenia*, *Luperus*.

778. *Criocerites* (*Criocerites*). Larva more linear and elongate. Feeds on the leaves or within the stems of vegetables. Pupa generally changes in a silken cocoon, attached to the stems or roots of the vegetables on which it feeds. Imago with moniliform antennæ, slightly incrassated externally, about as long as in the *Galerucites*; mandibles arcuate, bifid at the apex; maxillæ obtuse; galea incrassated, but not palpiform; prothorax proportionately much smaller than in any other order of the stirps: somewhat cylindrical; tarsi four-jointed; colours brilliant; flight only occasional, diurnal. Inhabits vegetables. *Crioceris*, *Donacia*.

779. Necked capricorn-beetles (*Lepturites*). Larva almost entirely without feet, fleshy, linear; inhabits decaying timber. Pupa changes in the same situations. Imago with filiform antennæ usually about the length of the body, inserted between the eyes, but not interfering

with their form; the head is elongated at its junction with the prothorax, somewhat in the manner of a neck; mandibles terminated generally in an acute point; maxillæ obtuse; galea obtuse, not palpiiform; form elongate, attenuated posteriorly; tarsi four-jointed, diurnal. Inhabits flowers, apparently feeding on their farina. *Lep-tura*, *Pachyta*.

780. Neckless capricorn-beetles (*Cerambycites*). Larva and pupa as in the preceding order. Imago with filiform antennæ, often much longer than the body, inserted close to the eyes, and partly surrounded by them; the eyes, consequently, become somewhat kidney-shaped, the head is not elongated at its junction, but is partly received into the prothorax; mandibles with an acute point; maxillæ and their galea obtuse; tarsi four-jointed; form elongate, nearly linear, slightly attenuated posteriorly: flight both diurnal and nocturnal. Inhabits the stems of trees, decayed wood, and sometimes flowers. *Molorchus*, *Clytus*, *Callidium*, *Cylindera*, *Obrium*, *Saperda*, *Lamia*, *Cerambyx*, *Prionus*.

781. Flat-bodied-beetles (*Cucujites*). Larva with six very short articulate legs; found in decayed timber. Pupa changes in the same situations. Imago with filiform antennæ generally not longer than the prothorax; mandibles acute, porrected, and elongate, especially in the males; the maxillæ obtuse; galea pilose; head somewhat triangular, elongated posteriorly into a kind

of neck ; prothorax nearly square, very flat ; body very flat ; tarsi four-jointed. Inhabits timber. *Cucujus*.

782. Timber-beetles (*Bostricites*). Larva a white maggot, completely without legs ; inhabits and feeds on the bark or wood of trees, causing their death with unerring certainty. Pupa changes in the same situations. Imago with clavated antennæ ; mandibles generally bidentate ; maxillæ with their galea obtuse ; the prothorax very convex, and usually as large as the remainder of the body ; tarsi four-jointed ; form cylindrical. Inhabits circular holes, which it bores in the bark and wood of trees, either to escape, after changing, from the pupa, or to deposit its eggs. *Cis*, *Bostrichus*, *Tomicus*, *Platypus*, *Hylesinus*, *Scolytus*, *Hylurgus*.

783. Long-nosed weevils (*Curculionites*). Larva without legs, and having occasionally in their place small mamillary processes ; inhabits and feeds on the flowers, fruits, seeds, leaves, stalks, bark, wood, pith, and roots of vegetables. Pupa changes in the same situations, sometimes naked, sometimes in a hard compact case, sometimes in a silken cocoon. Imago with antennæ generally twelve-jointed, incrassated externally, the basal joint generally very long, the others bending forwards at a right angle, forming an elbow ; these antennæ are placed on a long rostrum, which proceeds from between the eyes, and has the mouth at its

extremity; mandibles generally obtuse; blade and galea of the maxillæ united and indistinct; tarsi four-jointed. Mostly diurnal; feeds on vegetables. *Curculio*.

784. Short-nosed weevils (*Anthribites*). Larva in form like the preceding; feeds on wood. Pupa changes in the channels made by the larva. Imago with antennæ generally twelve-jointed, the basal joint not particularly elongate, therefore not elbowed, moniliform, incrassated externally, not situated on a distinct rostrum, much elongated in the males; mandibles and maxillæ nearly as in the preceding order; tarsi-four-jointed. Inhabits the bark and wood of trees. *Brachytarsus*, *Platyrhinus*, *Anthribus*.

785. False-weevils (*Salpingites*). Larva and pupa as in the preceding orders; the former feeds on the wood and bark of trees. Imago with antennæ shorter, moniliform, somewhat incrassated externally, and situated on a rostrum; mandibles and maxillæ obtuse; fore and middle tarsi five-jointed; hind tarsi four-jointed. Found in the same situations as the larva, and also among the leaves of trees. *Salpingus*, *Sphæriestes*.

CHAPTER VI.

OF THE CLASSIFICATION OF ORTHOPTERA.

786. THE metamorphosis of Orthoptera is isomorphous. Larva resembling the imago in structure, appearance, mode of feeding, &c. wings only being wanted. Pupa, or quiescent state, none. Imago with the parts of the mouth fully developed; labrum large and quadrate; mandibles strong, bony, masticatory, and moving horizontally; maxillæ with feelers, and a distinct, exarticulate, palpiform galea; fore wings coriaceous, little used in flight; hind wings longitudinally folded; flight weak and badly sustained.

787. Earwigs (*Forficulites*). The antennæ are many-jointed, moniliform, and decrease in size to the extremity; the fore wings square, coriaceous, meeting with parallel edges, very short, and not used in flight; the hind wings ear-shaped, folded, and projecting beyond the fore wings; hind legs not formed for leaping; tarsi three-jointed; telum

furnished with two appendages which meet like forceps; nocturnal insects, feeding on vegetables.

Forficula, Labia, Labidura.

788. Crickets (*Achetites*). Antennæ very long, slender, and composed of many joints; fore wings short, coriaceous, one partially covering the other, not used in flight; hind wings folded longitudinally, and projecting beyond the fore wings; hind legs incrassated, formed for leaping; tarsi three-jointed: nocturnal, subterranean insects, feeding on vegetables. *Gryllotalpa, Acheta.*

789. Grasshoppers (*Gryllites*). Antennæ very long, slender, and composed of many joints; fore wings coriaceous, as long as the hind wings, which are folded longitudinally beneath them; hind legs incrassated, formed for leaping; tarsi four-jointed; female furnished with an exserted oviduct: diurnal; feed on vegetables. *Gryllus.*

790. Locusts (*Locustites*). Antennæ short, incrassated towards the middle or extremity, consisting of about ten joints; fore wings coriaceous, generally as long as the hind wings, which are folded longitudinally beneath them; hind legs incrassated, formed for leaping; tarsi five-jointed; diurnal: feed on vegetables. *Locusta, Gomphocerus, Acrydium.*

791. Spectres (*Spectrites*). Antennæ short, stout, composed of few joints; fore wings coriaceous, small, short, often wanting, never covering the hind wings, not used in flying; hind wings

folded longitudinally, often very large and beautifully coloured, sometimes wanting; legs alike in structure, not formed for leaping; tarsi five-jointed; prothorax short: diurnal; feed on leaves. No British genus.

792. Walking-leaves (*Mantites*). Antennæ long, filiform, very slender, and composed of many joints; fore wings coriaceous, horizontal, generally covering the hind wings, which are folded beneath them; fore legs incrassated, and armed with teeth, longer than the middle and hind legs; tarsi five-jointed; prothorax long: diurnal; feed on other insects. No British genus.

793. Cockroaches (*Blattites*). Antennæ very long, filiform, tapering, and many-jointed; head bending beneath the prothorax; fore wings somewhat coriaceous, horizontal, one folding over the other, covering the hind wings, which are folded beneath them; legs alike in structure; tarsi five-jointed: nocturnal; voracious; omnivorous; run rapidly; fly badly; do not leap. *Blatta*.

CHAPTER VII.

OF THE CLASSIFICATION OF HEMIPTERA.

794. THE metamorphosis of the Hemiptera is isomorphous, resembling that of the Orthoptera. Imago with the parts of the mouth only partially developed; the mandibles are without any horizontal motion, but elongate and slender, and, together with the maxillæ and tongue, are inclosed in a sucker, which is composed of the labium principally, but protected above by the labrum; this sucker is bent beneath the head and breast, excepting when in use, when it is usually thrust perpendicularly into the rind of vegetables, or skin of animals, to extract the sap or blood, which, in this class, constitute the food; the feelers are obsolete.

795. Bugs (*Cimicites*). Antennæ elongate, conspicuous, four- or five-jointed; fore wings with the basal portion coriaceous, the apical portions which cross each other membranaceous; the legs are of

uniform structure, not formed for leaping ; the tarsi are three-jointed : terrestrial ; run fast ; fly rapidly, but not far at a time ; feed generally on the sap of vegetables, sometimes on other insects, and occasionally, but apparently unnaturally, on the blood of vertebrate animals. *Cimex*, &c.

796. Water-bugs (*Hydrometrites*). Antennæ elongate, conspicuous, four- or five-jointed ; fore-wings coriaceous, of uniform substance ; hind-wings membranaceous ; all the wings linear ; legs of uniform structure, very long, not formed for leaping ; tarsi three-jointed ; body elongate, linear : aquatic, running with ease and rapidity on the surface of water. *Hydrometra*, *Gerris*, *Velia*.

797. Water-scorpions (*Nepites*). Antennæ very short, concealed below the head ; fore-wings coriaceous, crossed at the apex ; hind-wings membranaceous, completely concealed beneath them ; fore-legs hooked, predatory ; tarsi with a single joint ; middle- and hind-legs not formed for swimming ; tarsi two-jointed ; tail armed with two long setaceous appendages : aquatic ; carnivorous ; crawl on aquatic plants, but do not swim. *Ranatra*, *Nepa*.

798. Water-boatmen (*Notonectites*). Antennæ very short, concealed below the head ; fore- and hind-wings as in the preceding ; fore-legs unarmed, middle- and hind-legs formed for swimming ; all the tarsi two-jointed ; tail without appendages : aquatic ; carnivorous ; swim with

ease, swiftness, and elegance; cannot crawl on aquatic plants like the preceding. *Naucoris*, *Notonecta*, *Corixa*, *Sigara*.

799. Frog-hoppers (*Cicadites*). Antennæ very short, scarcely projecting beyond the head; fore-wings coriaceous, meeting with a straight suture; hind-wings membranaceous; hind-legs incrassated, formed for leaping; tarsi three-jointed: most of the genera leap readily, but fly badly. Inhabit vegetables, on the sap of which they feed. *Cicada*, *Cercopis*, *Membracis*, *Psylla*, &c.

800. Gall-insects (*Coccites*). Antennæ hirsute, long, moniliform, many-jointed; fore-wings semicoriaceous, of uniform substance; hind-wings wanting, or replaced by appendages similar to the halteres of *Diptera*; legs of uniform structure, not formed for leaping; tarsi two- or three-jointed in the male, with a single joint in the female; tail furnished with two long setæ. The females are apterous, and attach themselves to the bark and leaves of trees, on which they deposit their eggs, covering them with their bodies. *Coccus*.

801. Plant-lice (*Aphites*). Antennæ conspicuous, elongate, seven-jointed; fore-wings deflexed, meeting over the back with a straight suture; hind-wings much smaller and shorter; all the wings membranaceous; legs of uniform structure, not formed for leaping; tarsi two-jointed. Infest all vegetables, sucking the sap:

reproduction without union of sexes for many generations. *Aphis*.

802. Moth-blights (*Aleyrodites*). Larva oval, flat, and scale-like. Pupa changes within the skin of larva ; is quiescent. Imago with the antennæ filiform, conspicuous and six-jointed ; wings equally developed, both as to length and breadth, covered with a white, mealy substance like the scales of *Lepidoptera* ; legs of uniform structure, not formed for leaping. Sits on the under-side of the leaves of the plants on which the larva feeds. *Aleyrodes*.

CHAPTER VIII.

OF THE CLASSIFICATION OF NEUROPTERA.

803. THE metamorphosis of the seventh class, *Neuroptera*, differs in its different orders. Larva, with strong corneous mandibles moving horizontally, and six articulate feet, situated in pairs on the second, third, and fourth segments ; prehensile feet none. Pupa various. Imago usually with the organs of the mouth perfect ; the wings, fully developed, and resembling net-work.

804. White ants (*Termites*). Larva with long, filiform, multi-articulate antennæ ; strong, corneous, well-developed, and masticatory mandibles, and six elongate articulate legs : active, omnivorous, and apparently perfect ; in one genus living in immense societies. Pupa isomorphous. Imago with long, filiform, multi-articulate antennæ ; strong, corneous, masticatory mandibles ; wings fully developed, recumbent, reticulated ; tarsi three-jointed. *Psocus*.

805. Pearl-flies (*Perlites*). Larva with long, filiform, multi-articulate antennæ; strong, corneous, masticatory mandibles; telum furnished with two long, setiform appendages; active, carnivorous, aquatic. Pupa isomorphous. Imago with long, filiform, multi-articulate antennæ; strong, corneous, masticatory mandibles; wings fully and equally developed, reticulated, recumbent; the hind wings folded; tarsi three-jointed. Inhabits the banks of running waters, and is a very favourite food of fish; flight nocturnal. *Perla*, *Isogenus*, *Nemoura*.

806. Snake-flies (*Raphidiites*). Larva with filiform antennæ, and corneous, masticatory mandibles; active. Inhabits and feeds on decayed wood. Pupa isomorphous. Imago with moniliform antennæ; corneous, masticatory mandibles; large porrected head; elongate prothorax; wings uniformly and fully developed, recumbent, deflexed, not folded, beautifully reticulated; tarsi four-jointed; telum with a seta: flight diurnal, in the sunshine. *Raphidia*.

807. Lace-winged-flies (*Hemerobiites*). Larva, with filiform antennæ; prominent, corneous mandibles and maxillæ; sacciferous, carnivorous. Inhabits the leaves of vegetables. Pupa necromorphous; changes within the sack formed by the larva. Imago with long, moniliform antennæ; corneous, masticatory mandibles, wings fully and equally developed, not folded, beautifully

reticulated, deflexed; tarsi five-jointed; smells fetid; flies mostly in the evening. *Hemerobius*, *Chrysopa*, *Osmylus*.

808. Stone-flies (*Phryganites*). Larva with short antennæ; corneous, masticatory mandibles; sacciferous, aquatic. Pupa necromorphous, changes in the sack formed by the larva. Imago, with very long, multi-articulate, filiform antennæ; mandibles and maxillæ obsolete; fore wings deflexed, very hairy; hind wings ample, much folded longitudinally, not so hairy; tarsi five-jointed. Inhabits the neighbourhood of water; flies in the evening and during the night, and is a favourite food of fish. *Phryganea*.

809. Caddew-flies (*Ephemerites*). Larva with long, filiform antennæ; corneous, masticatory mandibles; six articulate legs; aquatic, carnivorous. Pupa isomorphous. Imago with short concealed antennæ; mandibles and maxillæ obsolete; fore wings fully developed; hind wings small or obsolete; all the wings beautifully reticulated, erect, and meeting above the back; tarsi four-jointed; telum furnished with long setiform appendages: flight in the evening, in company, rising and falling, and is the favourite food of fish. *Ephemera*, *Baëtis*, *Cloëon*.

810. Dragon-flies (*Libellulites*). Larva with short antennæ; corneous, masticatory mandibles; very elongate, jointed, and remarkable labium, furnished with predatory, acute, mandibuliform

palpi; aquatic, carnivorous. Pupa isomorphous. Imago with minute antennæ nearly concealed; strong, corneous, masticatory mandibles; labium of moderate proportions; wings of uniform development, beautifully reticulated, porrected laterally or meeting vertically above the back; tarsi three-jointed; flight rapid, well sustained; active, carnivorous. *Agrion*, *Libellula*, *Æschna*.

811. Scorpion-flies (*Panorpites*). Larva and pupa unknown. Imago with long, filiform, multi-articulate antennæ; mandibles and maxillæ corneous, produced into a beak; wings of equal development, horizontally recumbent on the back; tarsi five-jointed; telum armed with an appendage resembling a lobster's claw: flight weak, of short duration, diurnal. Inhabits abundantly the woods and hedges of England throughout the summer. *Panorpa*.

CHAPTER IX.

OF TICKLERS, BEE-PARASITES, FLEAS, THYSANURA,
ANOPLURA ; AND CONCLUDING OBSERVATIONS.

812. MANY of the orders characterised in the preceding chapters still require further division before we arrive at families ; this is particularly the case with the Papilionites, Cimicites, and Cicadites : other orders limited to a single genus, as Panurgites, may, perhaps, eventually, when better known, merge in some neighbouring order.

813. Besides the orders already described under their respective classes, there are others which do not appear to range under either class ; nor do they appear intermediate between either of the classes connecting them together : these are Thripsites, Stylopites, and Pulicites.

814. Ticklers (*Thripsites*). Larva and pupa unknown. Imago with antennæ eight-jointed ; mandibles long, corneous, and possessed of horizontal motion ; fore and hind wings membranaceous, linear, ciliated, of nearly equal length ; tarsi two-jointed. Inhabits flowers, feeding on the

farina: when running on the skin, causes an intolerable itching. *Thrips*.

815. Bee-parasites (*Stylopites*). Larva apod, with a corneous head: inhabits the bodies of bees in the imago state, the head of the larva projecting between the segments. Pupa changes in the same situations; the mode of change not having been yet satisfactorily ascertained.

816. The parts of the mouth of this curious insect, as far as we know them, are these: mandibles elongate, linear, without horizontal motion; maxillary feeler fully developed, but the maxillæ very minute; labium distinct and triangular, but the labial feelers obsolete.

817. The prothorax is a very slender segment, almost lost in the mesothorax; the mesothorax is large and conspicuous, having its scutellum remarkably elongate and developed; the anterior part of this segment bears two very remarkable appendages, which the insect keeps in constant motion; behind these appendages are the fore wings, which are membranaceous, ample, and fold horizontally.

818. The metathorax is a minor, yet very apparent segment: it protrudes on each side of the scutellum of the mesothorax, and bears a pair of crumpled opaque wings, which are somewhat pedunculated, and much resemble the halteres of some flies. *Stylops*.

819. Fleas (*Pulicites*) constitute another very curious order. Larva elongate, slender, parasitic

on young animals, inhabiting the hair or down, particularly of pigeons in a domesticated state. Pupa perfectly quiescent, with little appearance of the perfect insect; changes in the same situations.

820. Imago with antennæ many-jointed; usually concealed in cavities in the skull, but capable of being erected at pleasure; mouth as in the blood-sucking Diptera; eyes simple; wings none; segments of the body thirteen, equally developed; hind legs formed for leaping. The flea is an inhabitant of all countries, feeding on the blood of animals. *Pulex*.

821. It must also be observed, that several genera are not referred to any of the foregoing orders: this arises from a doubt occurring as to their correct situation; a point not always to be decided without a knowledge of the insect in all its stages.

822. The other tribe of animals with six jointed legs (Aptera), contains comparatively but a very small number of species; they are distinguished from the Tetraptera by undergoing no change in external appearance after leaving the egg, and are invariably without the slightest appearance of wings. The Aptera are divided into two classes.

823. In the first class (*Thysanura*) the mouth has the usual parts fully developed; a labrum, a labium, two mandibles and two maxillæ; the mandibles have a perfect masticatory power, and

move horizontally ; the telum is armed with setæ, and the body covered with hairs or scales. This class contains two orders.

824. *Lepismites* (*Lepismites*). Antennæ very long, composed of a great number of joints, often more than forty ; the telum is furnished with three long setæ, composed, like the antennæ, of many joints ; it is not capable of being bent under the insect. *Forbicina*, *Petrobius*, *Lepisma*.

825. Spring-tails (*Podurites*). Antennæ shorter, never apparently composed of more than four joints, although the last has numerous rings, which may, perhaps, be considered joints by some : the telum is furnished with two setæ, and is bent under the body, giving an amazing saltatory power to the insect. *Podura*, *Smynturus*.

826. In the second class (*Anoplura*) the mouth appears very imperfect ; in one order there are mandibles with an horizontal motion, in the other, they are elongate, rigid, and united ; the telum is not furnished with appendages. The insects composing the class are entirely parasitical on other animals. This class contains two orders.

827. Lice (*Pediculites*). Mouth with the mandibles and other parts united, and forming a short blood-sucking tube : the animals composing this order are found on the bodies of mankind, dogs, pigs, cattle, &c. *Phthirus*, *Pediculus*, *Hæmatopinus*.

828. Bird-lice (*Nirmites*). Mouth with distinct

mandibles, which have a decided horizontal motion ; the other parts are rudimental ; the opening of the pharynx is very large. The animals composing this order are found on birds. *Trichodectes*, *Docophorus*, *Nirmus*, *Lipeurus*, *Goniodes*, *Colpocephalum*, *Trinoton*, *Læmobothrion*, *Eureum*, *Physoptomum*.

829. Summary of the Classes, Stirpes, and Orders of the Amorphous Tetraptera.

I. LEPIDOPTERA		Pulicites*	Empites
Sphingina		—	Tachydromiites
Sphingites			Dolichopites
Papilionina	II. DIPTERA.	Tipulina	Syrphina
Hesperites		Cecidomiites	Xylophagites
Papilionites		Tipulites	Stratiomites
Geometrina		Mycetophilites	Chrysotoxites
Geometrites		Rhyphites	Syrphites
Noctuina		Bibionites	Helophilites
Phytometrites		Scatopsites	Volucellites
Noctuities		Culicina	Rhingites
Phalænina		Simuliites	Muscina
Arctiites		Culicites	Muscites
Bombycites		Psychodites	Scatophagites
Phalænites	Tabanina		Tetanocerites
Notodontites		Cyrtites	Tephritites
Xyleutites		Bombiliites	Phytomyzites
Ægeriites		Tabanites	Phorites
Pyrulina		Anthracites	Borborites
Glaucopites		Stomoxites	Hippoboscina
Pyrallites		Conopites	Carnites
Crambites		Æstrites	Hippoboscites
Tineina	Asilina		Nycteribiites
Yponomeutites		Leptites	—
Tortricites		Therevites	Stylopites
Tineites		Asilites	
Alucitites		Midasites	

830. Summary of the Classes, Stirpes, and Orders of the Necromorphous Tetraptera.

III. HYMENOPTERA	Sphecina	Sphecites
Formicina	Scholiites	Larrites
Formicites	Sapygites	Bembicites
Mutillites	Pompiliites	Crabronites

* It is uncertain to what stirps the orders thus separated properly belong.

Vespina	Cephites	Nitidulites
Vespites	—	Silphites
Masarites	IV. COLEOPTERA	Spheridiites
Apina	Blapsina	Hydrophilites
Lithurgites	Blapsites	Helophorites
Panurgites	Helopites	Carabina
Andrenites	Mordellites	Gyrinites
Melliturgites	Pyrochroites	Dytiscites
Apites	Cantharites	Carabites
Apathites	Anthicites	Cicindelites
Chrysites	Buprestina	Staphylinites
Ichneumonina	Ptinites	Pselaphites
Proctotrupites	Clerites	Scydmaenites
Mymarites	Melyriites	Chrysomelina
Chalcites	Lampyrites	Endomycites
Cynipites	Cebrionites	Coccinellites
Evaniites	Elaterites	Cassidites
Ichneumonites	Buprestites	Chrysomelites
Braconites	Scarabæina	Alticites
Sirecina	Cetoniites	Galerucites
Sirecites	Melolonthites	Criocerites
Xyphidriites	Trogites	Cerambycina
Xyelites	Scarabæites	Lepturites
Oryssites	Lucanites	Cerambycites
Tenthredinina	Histerites	Cucujites
Allantites	Byrrhites	Bostricites
Hylotomites	Silphina	Curculionites
Tenthredinites	Dermestites	Anthribites
Lydites	Ipsites	Salpingites

831. Summary of the Classes, Stirpes, and Orders of the Isomorphous and Anisomorphous Tetraptera.

V. ORTHOPTERA	VI. HEMIPTERA	VII. NEUROPTERA
Forficulina	Cimicina	Termitina
Forficulites	Cimicites	Termites
Achetina	Hydrometrina	Perlina
Achetites	Hydrometrites	Perlites
Gryllina	Nepina	Raphidiina
Gryllites	Nepites	Raphidiites
Locustina	Notonectina	Hemerobiina
Locustites	Notonectites	Hemerobiites
Spectrina	Cicadina	Phryganina
Spectrites	Cicadites	Phryganites
Mantina	Coccina	Ephemerina
Mantites	Coccites	Ephemerites
Blattina	Aphina	Libellulina
Blattites	Aphites	Libellulites
Thripsites	Aleyrodites	Panorpites

832. Summary of the Classes, Stirpes, and Orders of the Apterā.

I. THYSANURA.

Lepismīna.

Lepismītes.

Podurīna.

Podurītes.

II. ANOPLURA.

Pediculīna.

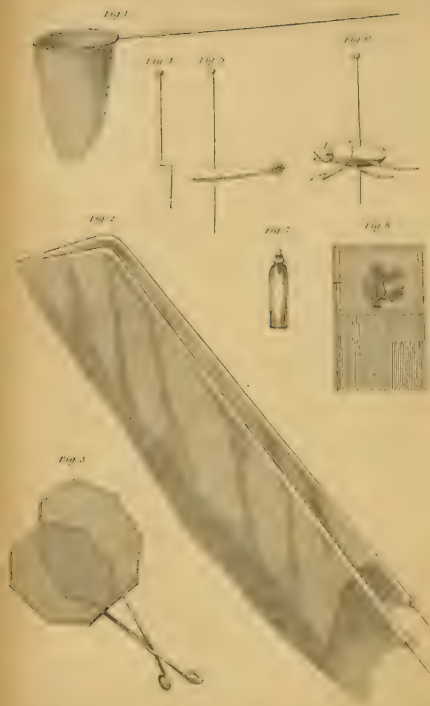
Pediculītes.

Nirminā.

Nirmītes.*

* In the summary of Tetraptera, the termination *ptera*, signifies a class; *ina*, a stirps; and *ites*, an order. In the summary of Apterā, the termination *ura*, denotes a class; *ina*, a stirps; and *ites*, an order.

END OF THE CLASSIFICATION OF INSECTS.



THE
GRAMMAR
OF
ENTOMOLOGY.

BOOK IV.
PRESERVATION OF INSECTS.

The value of a thing lies much more in its usefulness than its splendour.

CHAPTER I.

APOLOGY FOR THE COLLECTOR OF INSECTS.

833. PETER PINDAR, in his tale of Sir Joseph Banks and the Emperor of Morocco, not only gives the opinion of the unlettered rustic on the subject of insect hunting, but his own opinion, and the opinion of ninety-nine persons out of a hundred, even at the present day ; namely, that a person who could take an interest in pursuing a butterfly is a madman.

834. The collector of insects must, therefore, make up his mind to sink in the opinion of his friends ; to be the object of the undisguised pity and ridicule of the mass of mankind, from the moment in which he commences so insignificant a pursuit : and precisely in proportion as he enters on the subject scientifically will this pity and ridicule increase.

835. Argument with others, in these cases, is wholly useless : but each individual may say to

himself thus :—Insects are wonderfully and beautifully made ; they appear equal, often superior, in structure and in powers to any other work of the great Creator ; he, moreover, in their unaccountable instincts, appears directly to guide the actions of each without the medium of reason or memory. How can these beings, thus so immediately under the care of the Creator, be too insignificant for me to notice ?

836. It is further objected against the entomologist, by those who would allow there is something worth consideration in this query, that he unnecessarily takes away animal life ; that he causes unnecessary pain ; and that the pursuit is altogether hardening to the heart.

837. As to taking life : we meet with few individuals in common life but would consider it a pleasant and praiseworthy action to tread on a worm in his garden, or to crush a wasp or a spider in his window, and this for the avowed sake of his personal convenience ; an entomologist might take the lives of the same beings for his personal gratification in a scientific view ; surely, *self* being the object in both instances, the charge of cruelty is equally applicable to each.

838. But let us go farther : the common destroyer has heard of some wonderful mischief done by the worm, the wasp, and spider ; he therefore kills as many as possible. The entomologist knows their history ; he knows they do much

more good than harm; he therefore kills as few as possible. The animosity against these tribes originates in a want of knowledge of entomology.

839. As to causing pain. To support this charge it is insisted, that were we treated as we treat insects, we should suffer intense agony. This is very true, but very poor argument; because, before we can reason from ourselves, we must prove a similarity of circumstances. If a man could walk about for days without his head, and if his head continued eating and drinking for days without a body, then it would be fair to judge of the sensations of an insect by the sensations of a man, for the heads and bodies of insects freely perform these feats.

840. As to hardening the heart: entomologists, with constantly regarding the beautiful structure of insects, acquire such a kind feeling for them that they seldom or never unnecessarily kill them, and almost invariably take much more care than indifferent persons to avoid doing them any injury; and the various schemes which have been invented for killing insects in the most expeditious manner prove, at least, that the entomologist is not willing to occasion them suffering.

CHAPTER II.

OF THE DRESS AND INSTRUMENTS FOR THE
COLLECTOR OF INSECTS.

841. INSECTS may be taken in nearly all places, at nearly all times, and under nearly all circumstances; but still it is necessary to describe those places, times, and circumstances, which insure the greatest success. However, before starting the entomologist on his hunting excursion, we must fit him out for his employ.

842. Dress is an article of great importance, both as to material and make. The best material with which the author is acquainted is called lasting. It has these advantages: it is light; it keeps out much wet; it does not catch the thorns of brambles and other bushes; it does not feel cold when wet. These are matters not to be despised by him who often wanders for hours without a chance of shelter.

843. The best colour is green ; as to shape of coat, the common shooting jacket is by far the most convenient. There should be ample cross pockets outside, on the hip ; also several breast pockets, particularly two (at least) very small ones for glass vials containing spirits, to stand upright in : these should be inside the left breast of the coat, so that the right hand can conveniently reach them.

844. Close to these vial pockets, and sewed into the stuff of the coat, should be a large pin-cushion, containing two or three different sizes of pins, so arranged, in three columns, that the hand might at once take of either kind without the assistance of the eye to direct it. Two sizes of pins are all that are generally required ; but a third kind, very slender indeed, is used for very minute moths.

845. There are three shops in London, and perhaps more, at which pins are sold expressly for the use of entomologists : these are, Bew's, in Newgate Street, Durnford's, in Gracechurch Street, and Hale's, in the Dovor Road ; but the art of making pins is not yet arrived at sufficient perfection to satisfy the entomologist. The universal fault is, that the heads come off, and then the insect on the pin cannot be moved without great risk.

846. The principal implements of the collector are boxes and nets. The boxes should be of

mahogany, opening readily, on brass hinges ; length seven inches, breadth four inches, depth two inches ; the top and bottom should be lined with fine soft cork, and covered with white paper. The pockets of a shooting jacket will readily carry three or four such boxes as these.

847. Besides these boxes, there should be two long cylindrical tin boxes for the caterpillars of *Lepidoptera* : the tin not only keeps the caterpillars cool, but it causes the leaves on which they feed to retain their freshness many days. Tin boxes are also useful to bring home *Diptera* alive : in this case a cylinder of tin passes through the lid of the box, and is corked at the top.

848. The nets used by entomologists are of many kinds ; the following are the best : first, the forceps with a handle like that of scissors, with holes for the finger and thumb, and two circular or octagonal frames of iron, on which muslin or cheese cloth is stretched. This instrument is particularly useful for taking the *Diptera* and *Hymenoptera*, which settle on umbellate flowers. The forceps should be kept in the right hip pocket of the coat.

849. The second net is the water net. It is composed of a strong hoop of iron, jointed so as to fold up in a convenient form ; on this hoop is fastened a strong bag net, made of cheese cloth ; the hoop has a male screw which fits a female screw at the end of a stout stick, about four feet in length.

With this instrument all water insects are taken ; the water straining off through the net, and the insects remaining at the bottom.

850. The same net, or another lighter one of similar form, screwed on a similar or the same stick, is called the sweeping net, and is used for sweeping grass, on which myriads of minute insects are always to be found : the weeds on the banks of rivers and canals are also excessively productive in insects, which can only be taken in this manner.

851. The clap net is the grand weapon of the entomologist : it is a large piece of muslin, four feet long, and nearly three wide. It is supported on two light rods, which pass along a border made of brown holland, or other strong substance, bent towards each other at an obtuse angle, and meet at the top of the net : one of these rods is held in each hand.

852. This net is the best for pursuing butterflies and moths on the wing ; the hunter tries to get the net under the object, and strikes upwards, closing the rods at the same time. A loose bag is formed, by a fold of the muslin, across the bottom of the net : this prevents any thing from getting out. The same net is held in one hand under the boughs of trees, &c., while these are beat by the stick of the water net held in the other hand ; and thus, besides perfect insects, a great number of caterpillars may be obtained.

853. The rods of the clap net are each composed of five pieces, united by ferules ; when taken to pieces and placed in the net, the latter may be folded in a very moderate compass, slipped into a brown holland case, and put in the coat pocket. For this kind of net both green and white muslins are used ; but white is much the best, as the small insects are much more readily distinguished on it.

854. The entomologist should be provided with two vials ; one empty and perfectly dry, having a quill passing through the cork, and going a considerable way below it : this quill may be stopped at top by a second small cork. The other vial should be three parts filled with spirit : common whisky is the best spirit ; pure alcohol injures the colours of beetles, and gin makes them sticky.

855. A digger is another useful instrument : it is simply a piece of round iron, about fifteen inches long, bent round at the one end, and furnished with a wooden handle at the other. This serves to rip the bark off dead trees, and to dig at the roots of trees for chrysalides.

856. The best place to get entomological instruments, with which the author is acquainted, is Bew's, in Newgate Street ; Mr. Benj. Standish, of George Street, Peckham, is also a manufacturer of nets and boxes, and the Messrs. Christy, of Standgate Glass-works, Lambeth, have taken great pains to make entomologists' vials, and have

succeeded in producing a most unexceptionable article.

857. Finally, pill boxes, obtainable of any druggist, complete the outfit of the entomologist. There is now an excellent kind manufactured, of which the tops and bottoms never come out, owing to a little management in avoiding the usual pressure : it is important to get these. It is important also to avoid sitting on pill boxes, as it must interfere with their structure : to avoid this, the author carries them in a breast pocket.

CHAPTER III.

ON CAPTURING INSECTS.

858. HAVING equipped the collector, we must accompany him to the chase. As soon as the sun has warmed the earth by those brilliant and cloudless days which we always have in March, earth, air, and water, teem with insects : in May the numbers seem doubled ; from that month they decrease to November, when they have again almost entirely disappeared.

859. As to the respective numbers, size, and beauty, of the different classes, we must say a few words. Of known species, the Hymenoptera far exceed each of the others in number, and probably all of them put together ; almost every species of the other classes has one Hymenopterous parasite.

860. Next to the Hymenoptera in number, the Coleoptera and Diptera appear to excel ; then the Lepidoptera : the Hemiptera are about a

quarter as many as the Lepidoptera, the Neuroptera still less, and the Orthoptera least of all.

861. In size and beauty the Lepidoptera and Neuroptera greatly excel ; but both these classes contain also a great number of minute and apparently insignificant species : the Coleoptera rank next in these respects, and the Diptera and Hymenoptera contain the smallest. In the order Mymarites are insects so small that they may now be traversing this page, unnoticed by the reader.

862. The haunts of Lepidoptera are very various. Butterflies are to be taken chiefly in the sunshine ; they delight in the honey of flowers, and fields of clover ; lucerne and tares greatly attract them. Sphingites fly at every hour : they delight more in tubular flowers ; the honeysuckle and jasmine are especial favourites.

863. The Geometrites fly in the dusk of evening, but may be easily disturbed and caught in the day ; their flight is slow, soft, and feathery. The Noctuites, and all the heavy moths, fly in the night ; they are excessively rapid on the wing ; they settle on yew berries to suck their sweets, also on sugar, when put out to attract them. An empty sugar hogshead is an excellent decoy.

864. All night-flying moths are attracted by the light of a lamp or candle ; and some entomologists, availing themselves of this propensity, sally forth to the woods at night, having a bull's-eye lantern strapped to them, and with the clap

net almost ensure success. Others, less venturesome, illuminate their rooms, and hold a levee of moths the whole night long; this plan allows of reading or writing at the same time: the window may be shut, and the moths flying against the window, will knock for admittance.

865. The *Ægeriites* and *Glaucopites* flutter sylph-like over flowers, in the hottest sunshine; and the little *Tortricites*, &c. with which the class terminates, fly at sunset. All moths may be occasionally beaten out of shrubs and bushes while at rest during the day, and may also be found sitting against palings, trunks of trees, &c.

866. The second class, *Diptera*, is composed of gnats and flies: these occur in all situations. The latter may be swept off grass in abundance, or taken with the forceps settling on umbellate flowers.

867. The *Hymenoptera* have a very various economy. Ants may be found every where running on the ground; *Sphecites* and the neighbouring orders frequent sunny sand banks; wasps are found where there are sweets of any kind; bees frequent flowers and sunny sand banks in the spring: all the parasites may be beaten off shrubs, swept off grass, &c.; and the *Tenthredoes* frequent leaves and flowers in the early summer.

868. The *Coleoptera* are to be found every where on the flowers, leaves, and stems of living shrubs, in the bark, under the bark, and in the wood of

dead or dying trees, in the carcasses of dead animals, in all kinds of dung and rubbish, under stones, in flour, in cellars, in sand and gravel pits, at the roots of grass, in moss, in water, or flying in the air.

869. Of Orthoptera we have but few : earwigs abound in the crevices of bark and palings, or any shelter by day, and run every where by night ; cockroaches and crickets frequent houses ; grasshoppers, the fields, particularly in the autumn.

870. Of the Hemiptera, the Cimicites, Cicadites, and Aphites, inhabit plants ; the Hydrometrites run on the water ; and the Nepites and Notonecrites swim beneath its surface.

871. In the Neuroptera all but the dragon-flies settle on shrubs during the day, particularly in the neighbourhood of water, and may be very readily beaten into the clap-net : the noble dragon-flies may be seen over ponds, hawking about for their insect prey.

872. The entomologist who has in his neighbourhood different descriptions of soil and different degrees of altitude, different kinds of cultivation, or the absence of cultivation, as morasses, heaths, commons, forests, should try each and all ; he will find that all these differences make corresponding differences in the produce.

873. Besides the perfect insects, in every excursion the collector will be sure to meet with numbers of larvæ, particularly those of Lepidoptera

and *Tenthredo*s: unless he know these to be so very common that they are not worth the trouble of rearing, he should invariably bring them home in the tin boxes.

874. To rear larvæ it is necessary to be provided with numerous little square cages, lined about half way down with gauze; the lower portion should be made of stout wood, and should have an internal coat of tin or lead; this part should be filled with common earth: sprigs of the plant on which the larva was feeding should be placed in a vial in this breeding cage, and the larva placed on it. The boxes must be kept in a cool and moist place.

875. Larvæ will do as well thus artificially reared as in a state of nature; they will spin among the leaves, or on the sides of the cage, or they will bury themselves in the earth; in either case the moths emerge at the proper time, and will be more perfect and finer specimens than can be obtained in any other way.

876. In the boxes in which larvæ are kept, *Ichneumon*s will be constantly making their appearance; these ought to be preserved with great care, and a memorandum kept of the species of moth, if known, from which they emerged.

877. As to the particular seasons for insects, little can be said: butterflies are particularly abundant in May, August, and September; moths in May, June, and October; larvæ in May, June,

and September. All the tribes that frequent flowers have some particular flower that they more approve, and the entomologist must make his own observations.

CHAPTER IV.

OF KILLING AND SETTING INSECTS.

878. ALTHOUGH the author is fully satisfied that insects have not the acute sense of pain possessed by ourselves and warm-blooded animals, yet he wishes to impress on the collectors of insects, that it is unjustifiable to subject any animals to even the possibility of suffering for our own gratification.

879. Therefore let us resolve to adhere to two rules; *first*, to destroy no more specimens than are really requisite; *secondly*, to kill them in the most certain and expeditious manner: under any circumstances, the reflection that we have done this will be agreeable.,

880. Butterflies and moths require to be pinned immediately on being taken: the pin is passed through the scutum of the mesothorax, in the very centre, the finger and thumb of the left hand, at the same time, pinching the insect under the

wings. A slight pinch kills a butterfly, but it is far otherwise with a thick-bodied moth; these seem to possess an excess of vitality.

881. There are several modes by which moths may be killed, but some of these are not at all times convenient; however, it will be best to give them all, and then the reader may avail himself of one or other of them according to circumstances.

882. *First*, Take the moth by the wings, held together over its back, and then dip its body suddenly in boiling water; immediately on withdrawing it, it will be found that life and motion are completely extinct; but the downiness of the body will have received an injury which it never effectually recovers.

883. *Secondly*, Fix a piece of thin cork firmly at the bottom of a gallipot; then, having pinned the moth, as before described, through the mesothorax, stick the pin in the cork, and invert the gallipot in a basin of boiling water: the steam produces death almost instantly, and does not injure the plumage of the moth.

884. *Thirdly*, Having pinned the moth, take its body between the finger and thumb of the left hand, then withdraw the pin, and having previously prepared a sharp-pointed piece of quill or wood, dip it in Prussic acid, or a strong solution of oxalic acid, and introduce it into the aperture made by the pin: death follows almost instantly.

885. If two or three laurel leaves are completely

crushed between stones, or otherwise, and the fragments placed in the corner of a collecting box, the fumes will, in a few minutes, be fatal to any insects placed there: the leaves should be withdrawn and replaced by fresh ones every half hour, if possible, and then insects may be pinned and placed in the box without further care during a whole day.

886. Diptera and Hymenoptera are generally best carried home alive in pill boxes; the same also with very minute moths: Coleoptera of almost every kind may be safely immersed in the vial of spirits: Orthoptera and Hemiptera, if large, may be pinned; if small, put in pill boxes: dragon-flies require to be pinned.

887. Diptera and Hymenoptera should, when sufficiently large, be pinned, like the Lepidoptera, through the centre of the mesothorax; Coleoptera, through the right wing case; Orthoptera, through the prothorax; and Hemiptera, through the mesothorax, generally in this class a triangular plate: dragon-flies should be pinned in the centre between the four wings.

888. All insects taken home alive in pill boxes, may be killed thus:—Open the lids of the boxes a very small way, just so as to admit the passage of air, but not the exit of the insect; then make a pile of the boxes, thus partially opened, on a piece of soft leather placed on a table; invert a pint basin over the boxes; burn one or two matches under the basin.

889. If the basin and boxes are placed close to the edge of the table, the facility of burning a match under the basin is increased. The basin should be pressed down, and the leather precludes the ingress of fresh air, and the egress of the sulphur smoke; if the boxes are examined in a few minutes, the insects will be found perfectly dead.

890. All kinds of insects are killed instantaneously by immersion in boiling water; and with the exception of *Diptera* and *Lepidoptera*, none are materially injured by the process. The beetles brought home in spirits should be subjected to this process, first, as a cleansing and purifying operation, secondly, because the spirit appears only to stupify and deprive them of motion, so that without this second killing they generally revive.

891. All insects killed in water should be very carefully spread on blotting paper; those large enough for pinning should be then selected, and left until thoroughly dried; those which are so small as to be injured by a pin should be removed to a sheet of pasteboard; each should then be floated in a drop of water; then the water should be withdrawn by a camel's hair brush.

892. The legs and wings usually spread out neatly without assistance, but if they do not, a little assistance from the brush will accomplish it; the board should then be put carefully away, and the insects will dry in the position in which they

were left, but are so slightly attached to the board that a touch of the pencil will remove them.

893. A number of very small pieces of card should then be prepared ; they should be triangular, with one angle very acute ; a pin should be passed through each near the base ; then with a fine brush touch the acute point of the card with clean transparent gum-water, and again moistening the brush take up one of the insects and place it on the gum, to which it will instantly adhere.

894. All minute Hymenoptera may be mounted in this way. The wings of minute Diptera are more difficult to deal with, being of a softer texture. As few of these should be mounted as possible, and great care should be exercised in the operation ; the rest of the Diptera should be pinned.

895. The minute insects brought home alive in the vial may be instantly killed by immersing the vial in hot water, after which they may be mounted at any future opportunity when more time can be spared for the operation : each vial should be labelled with the date and place, when and where, and thus a winter's amusement may be provided.

896. In setting, *i. e.* arranging the legs and wings of insects, we now speak of those sufficiently large to require pinning, there are two modes—the first is to place the wings horizontally, the second is to bend them so as to touch the drawer ; the first is the continental, the second the English, plan.

897. In setting insects with expanded wings, a piece of stiff card, pinned through with a stout pin, supports the wings from below; another similar piece is placed on the wings above; the two pieces holding the wing immovably fixed: the legs are held in their places by a bent pin. In Lepidoptera, Diptera, Hymenoptera, some Orthoptera, and in Neuroptera, the wings are thus spread, but not in Coleoptera.

898. In Coleoptera the habit would generally be totally destroyed by opening and spreading out the wings: insects of this class, and also generally those of the class Hemiptera, are set with the wings, and wing-cases quietly folded in the usual position on their backs; the legs and antennæ, however, are carefully placed, and arranged by means of the bent pins.

899. The bent pins are reduced to this more convenient shape by means of an instrument somewhat resembling a pair of pliers; it was invented by Mr. George Waring, of Bristol, and is now very commonly employed by all entomologists: the old plan was, to fasten a foot in its place by a small card brace.

900. The value of a collection of insects is of course very much enhanced by exhibiting them in all their stages; this, however, is but little attended to. A few of our larger Lepidopterous larvæ have been preserved in spirits, but this plan obviously precludes the simultaneous exhibition of

the larva and imago. Various other plans of preserving caterpillars have been tried; the following appears the best.*

901. If the caterpillar be hairy or spiny, enlarge the orifice of the anus, and from thence endeavour, by gentle pressure, performed with a smooth instrument, to squeeze out as much of the contents of the inside as possible: and while thus operating, let the subject be laid on a sheet of blotting paper, that the moisture exuded being imbibed, may be prevented from wetting and spoiling the hairs and spines.

902. This done, insert frequently fresh pieces of dry blotting paper rolled round the end of a smooth piece of stick, and continue to do so until the dryness of the paper, when retracted, indicates that no moisture remains within.

903. Let the skin be now distended into its proper shape, by means of a stuffing of down, or other soft materials, taking the precaution of guarding against the attacks of destructive insects, by enclosing within a small quantity of camphor, cayenne pepper, and red oxide of lead.

904. In preserving hairless caterpillars, care must be taken that their colours be not removed by a too rough application of the absorbing instrument. The chrysalis of Lepidopterous insects is very readily preserved: it requires to be left until thoroughly hardened; then vitality destroyed by

* Mr. FENNEL, in the *Entomological Magazine*.

immersion in boiling water; and, when dried, it is fit for the cabinet.

905. For all the operations of preserving insects nicely corked, setting boards about a foot square should be prepared, and on these all the insects should remain until perfectly dry and stiff; after which if kept in a warm room, there is little danger of their receiving any injury.

CHAPTER V.

OF ENTOMOLOGICAL CABINETS.

906. A WELL-made cabinet is of the greatest importance to the entomologist; he must attend personally to the building of it, unless he meets with a cabinet maker, who has had previous practice in the art.

907. A cabinet should consist of about thirty drawers in two tiers of fifteen each; it should be made of the best mahogany; the wood should be particularly well seasoned; the drawers should be enclosed in front by two folding doors, meeting in the middle.

908. Each drawer should be about fifteen inches square, and two inches deep, for English insects; about eighteen inches square, and two and a half inches deep, for foreign insects, on account of their superior size; it should be covered at the bottom with soft cork, and then neatly papered.

909. Round each drawer should be a cell for camphor, which preserves the specimens from mites, and the top of the drawer should be covered by a pane of flatted glass neatly fitted in a frame. Care must be taken to make this frame fit as nicely as possible in order to keep out dust.

910. Cabinets of this kind surmounted by a book-case are no dissight in a room ; three or four such cabinets surmounted may occupy the side of a room. In placing these cabinets side by side, care must be taken that the doors are so made as to open freely without any aperture between them.

911. Before the insects are placed in the cabinet, the papered bottoms of the drawers must be ruled in columns with a black lead pencil, the columns varying in width according to the size of the insect : the insects should then be placed in with great care and neatness, beginning with the *Lepidoptera*.

912. Mr. Samouelle, Mr. Stephens, and Mr. Curtis, have each published a list of British Insects, printed on one side only, purposely for labelling cabinets. The entomologist should select which of these he most approves, and cutting out the names, carefully fasten them in the drawer by means of pin-points ; in doing this he must use a pair of common pliers.

913. The generic names are printed in capitals ; these should be placed above the insect, and the specific names, printed in small characters, below.

Attached to each name is the initial or part of the name of the author who gave it, thus—*SPHINX Lin.*; signifying that Linnæus gave the name.

914. Lepidoptera should be placed with extended wings following each other in a line of three, four, or more, if a variable species; the upper specimens should be males, the lower females. Diptera, Hymenoptera, and Neuroptera, should be arranged in the same way.

915. Colcoptera should be placed in rows, three abreast; the upper three males, the lower three females. All these should have closed wings, as the under wings are not essential for any scientific purpose, neither do they in any way add to the beauty or neatness of a collection.

916. Orthoptera should be placed three males and three females abreast, as the Colcoptera, and then a single open winged specimen below them: the same plan should be adopted with the Hemiptera.

917. Preserved insects should be kept perfectly dry. They are subject to three very annoying casualties, which it should be the constant study of the entomologist to counteract; these are destruction by mites, &c., mouldiness, and greasiness.

918. Destruction by mites, the larvæ of Dermestites, Ptinites, and Tineites, is very much avoided by attending to three rules: put every specimen into the drawers perfectly dry; never

leave the glass off, and keep a good supply of camphor always in the drawer.

919. Either of these depredators makes itself instantly known, by an appearance of dust below the specimens attacked. The best way on discovering this, is to take out the insect, and if a beetle, to dip it instantly in boiling water; then, after thoroughly drying it, return it to its place. If any other insect, baking in a moderately hot oven will be found an effectual cure.

920. Mouldiness is completely remedied in beetles by immersion in boiling water, and after brushing them with a camel's hair pencil, drying them thoroughly, and returning them to their places; in other insects, spirits of wine carefully applied with a camel's hair pencil effects a cure.

921. Greasiness is a constant cause of trouble with insects, particularly moths. Commencing in the body, it gradually spreads until the whole moth looks as though it had been dipped in oil; from the insects the oil runs down on the drawer below it, soiling the paper, and spoiling the appearance of the collection. No preventive to this is known, but a greasy moth may be restored thus:—

922. Take out the moth, and place it on a setting board, then drop spirits of turpentine on it till it is completely saturated; afterwards scrape on it some very white pipe-clay, taking care to cover every part; in a few days the turpentine

will have dried, and the pipe-clay, having absorbed the grease, will readily come off on being moved by the point of a pen-knife. The moth will be quite restored, unless a very stout bodied one, in which case, the operation should be repeated.

CHAPTER VI.

ENTOMOLOGICAL BOOKS.

923. As the author intends this for an introductory work on Entomology, and has done his best to make it as complete as he was able, it would be but a poor compliment to his readers, after giving them so much trouble, were he to tell them of the necessity of buying other introductions.

924. Works descriptive of species, will, however, be found highly essential, and the author will give a list of all the British ones with which he is acquainted, and such foreign ones as he considers to be peculiarly useful; he will arrange the books in the same order in which insects are classified in the preceding Book.

925. *Lepidoptera*. — 1. British *Lepidoptera* (*Lepidoptera Britannica*), by Adrian Hardey Haworth, 1803, *et seq.*, being published in four parts. One volume, pp. 586, with plates. This work is written in Latin; it contains concise and accurate descriptions of the British *Lepidoptera*,

known at the time the author wrote, and very few have been discovered since.

926. 2. *Illustrations of British Entomology*. Part, *Haustellata*, by James Francis Stephens. Four volumes, with numerous plates. This work is written in English. It contains descriptions of all the known British *Lepidoptera*.

927. 3. *Conspectus of Butterflies and Moths*. by James Rennie. One volume, no plates. This work is written in English, and contains descriptions of nearly all the British *Lepidoptera*.

928. *Diptera*—Systematic description of the European two winged insects, by J. W. Meigen. In six volumes, with numerous plates. A short Latin description of each insect is given. The remainder of the work is entirely in German. Nearly all the British Species are described.

929. *Hymenoptera*—*Stirps, Formicina*. Natural History of Ants, and a collection of Memoirs and Observations on Bees, by P. A. Latreille, in one volume. The work is written in French. It contains descriptions of all the Ants (or nearly so) inhabiting this country.

930. *Hymenoptera*—*Stirps, Sphecina*. An Essay on the Indigenous Fossorial Hymenoptera, comprising a description of all the British Species of Sand-wasps, by W. E. Shuckard. This work has long been advertised; its author is completely competent to the task.

931. *Hymenoptera*—*Stirps, Vespina*. *Systema*

Piezatorum, by J. C. Fabricius. One volume, written in Latin. Since this work was published, much knowledge has been gained concerning the insects which it describes.

932. *Hymenoptera*—*Stirps, Apina*, Monograph of the Bees of England, (*Monographia Apum Angliæ*), by William Kirby, in two volumes, with plates. This work is written in Latin, and is the most perfect entomological work that any country has yet produced. Modern discoveries have, however, added some facts concerning identity of species.

933. *Hymenoptera*—Order, *Mymarites*. Essay on Parasitic Hymenoptera, by A. H. Haliday, published in the Entomological Magazine, Vol. I. p. 341. In this Essay the whole of the British species are described.

934. *Hymenoptera*—Order, *Chalcites*. Monograph of Chalcites (*Monographia Chalciditum*), by Francis Walker, published in the Entomological Magazine, Vol. I. pp. 12, 115, 367, 455. Vol. II. 148, 286, 340, and to be continued; this most laborious monograph will contain descriptions of every British species.

935. *Hymenoptera*—Order, *Evaniites*. Article Insecta, by William Elford Leach, published in the Edinburgh Encyclopædia, Vol. IX. p. 142. Three British genera and species described.

936. *Hymenoptera*—Order, *Braconites*. Essay on the Classification of British Hymenoptera, by A. H. Haliday, published in the Entomological

Magazine, Vol. I. pp. 259, 333, 480. Vol. II. p. 225, and to be continued. This laborious and scientific Essay (written in Latin) will include all the British species.

937. *Hymenoptera* — Order, *Ichneumonites*. European Ichneumonology (*Ichneumologia Europæa*), by J. L. C. Gravenhorst, three volumes, written in Latin. An excellent and most laborious work.

938. *Hymenoptera* — Stirpes, *Sirecina* and *Tenthredinina*. Monograph of the Tenthredoes (*Monographia Tenthredintareum*), by Le Pelletier de Saint-Fargeau, one small volume, written in Latin. Most of the British species are very clearly described in this work. It may here be observed, that we have no general work on Hymenoptera.

939. *Coleoptera*. 1. British Entomology (*Entomologia Britannica*), Vol. I., Coleoptera, by Thomas Marsham (written in Latin), one volume, without plates; a most invaluable book, on account of the neatness and scientific accuracy of the specific description.

940. 2. Illustrations of British Entomology, Part, Mandibulata, written in English, with a short Latin specific description of each species. Five vols., with numerous plates. This work contains descriptions of all the known British Coleoptera.

941. *Orthoptera*. The Entomologist's useful Compendium, by George Samouelle. This work

is written in English ; one volume, with numerous plates. It contains, at page 217, generic descriptions of the British Orthoptera. The author is not aware of any work which describes the species.

942. *Hemiptera*. The Entomologist's useful Compendium, by George Samouelle. This work contains, at p. 220, descriptions of all the British genera of Hemiptera. The author is not aware of any work which describes the species.

943. *Neuroptera*—Stirps, *Termetina*. Supplement to the Systematical Entomology (*Entomologia Systematica Supplementum*), by J. C. Fabricius. In this work many British species of Psocus are described.

944. *Neuroptera*—Stirps, *Perlina*. Memoir on the Larva of Nemoura, by F. J. Pictet, published in the Annals of the Natural Sciences, Vol. XXVI. p. 369 ; and of Perla, Vol. XXVIII. p. 44. Both these memoirs are written in French.

945. *Neuroptera*—Stirps, *Phryganina*. 1. Description of some Nondescript Species of May-flies of Anglers, by John Curtis, published in the London and Edinburgh Philosophical Magazine, Vol. IV.

946. 2. Researches into the History and Anatomy of the Phryganites (*Recherches pour servir à l'Histoire et à l'Anatomie des Phryganides*), by François Jules Pictet ; one volume, 20 plates ; a work of very great research and extraordinary merit.

947. *Neuroptera*—Stirps, *Ephemirina*. De-

scription of some Nondescript Species of May-flies of Anglers, by John Curtis; published in the London and Edinburgh Philosophical Magazine, Vol. IV.

948. *Neuroptera* — Stirps, *Libellulina*. Monograph of the European Dragon-flies (*Monographia Libellularum Europæarum*), by P. L. Vander Linden, 42 pages, without plates. This little work is written in Latin, and is very complete and excellent of its kind.

949. 2. Entomological Hours (*Horæ Entomologiæ*), by Toussaint de Charpentier, one vol. 4to, with plates. In this work the species of the genus *Libellula* are accurately described in Latin.

950. It seems necessary to say a few words on British periodical works on entomology. Of these we have no less than five; some of them, already alluded to, as containing monographs of genera, &c. We will take them in the order of seniority.

951. *British Entomology*, by John Curtis, F.L.S., published in two-monthly numbers; on the 1st of February, April, June, August, October, and December; containing eight highly finished coloured plates, illustrating the genera of British insects, dissection of the mouth, and other parts affording generic characters. Each number contains sixteen pages of letter-press.

952. *Illustrations of British Entomology*, by James Francis Stephens, F.L.S., published in

monthly numbers, on the last day of every month, containing, occasionally, coloured plates, and varying in its quantity of letter-press.

953. Entomological Cabinet, by George Samouelle, A. L. S., published in monthly numbers on the 1st of every month, containing six coloured plates, and twelve pages of letter-press.

954. Entomological Magazine, by various authors. This work is published in quarterly numbers, on the 1st of January, April, July, and October; containing one plate (generally uncoloured), and 104 pages of letter-press. It is open to all contributors.

955. Transactions of the Entomological Society of London, by various contributors; a single number only at present published. This work is to contain no uniform number of plates or letter-press, and the periods of publication not fixed. The 1st number has seven plates, some of them coloured; and 66 pages, besides an Appendix.

CHAPTER VII.

OF INVESTIGATING INSECTS.

956. HAVING pointed out the best mode by which a collection may be made, and the books which will be most useful in naming it, it remains that we add a few words on the application of objects to descriptions, and descriptions to objects.

957. We have repeatedly spoken of characters; we have explained the terms, systems of organs, and what those systems of organs are. Now let it be understood that character is the variation in the mode or measure of development of any integral portion of either system of organs.

958. Those characters are the best which are founded on such portions of a system of organs as are most readily observed; the organs of support afford these. It would be a work of insuperable difficulty had we to examine the interior of an insect to decide its species.

959. All animals have a tendency to vary in

those parts of the body which are the most remote from the centre: the extremities in quadrupeds, or in birds, afford us the best characters on this ground. Take a lobster, a prawn, a shrimp, and a crayfish; spread them on a setting board, you will find the extreme points, the tail, toes, and antennæ, display the differences: so, in insects, take the extremities.

960. The extremities of an insect are the wings, the tarsi, the head; and these afford abundant characters. First, take the most obvious parts, the parts most easily observed; then consult the more concealed parts, as the mouth; but even in the mouth try the palpi before the jaw or the lip from which they rise.

961. In investigating insects, a good glass is a matter of great importance; and here I cannot resist the pleasure it will give me most heartily to recommend Messrs. Bentley and Chant, of King's Head-court, St. Martin's-le-Grand. Being themselves good entomologists, they know exactly what entomologists require, and take every pains to supply it.

962. The knowledge of the principal order of insects is very soon acquired; many we have known from our childhood upwards, as *butterflies*, *Papilionites*, or *crickets*, *Achetites*. It is the safest plan to begin with large well-known groups first; the knowledge of a few of these leads us to desire an acquaintance with the rest.

963. After the orders are pretty well known, the study of species must be begun ; for it is a remarkable fact, which the author cannot explain, that classes, orders, and species, are much more readily ascertained, and much more obvious to the casual observer, than the intermediate divisions of stirpes, families, and genera.

964. It may also be observed, that in general, even with scientific investigators, there is less doubt as to the limits of classes, orders, and species, than those of the other divisions. Genera are the most difficult groups to make out ; they depend almost entirely on artificial characters, and their limits have never been agreed on by any two of the numerous writers on entomology.

965. Most descriptions are written in Latin, or a language intended for Latin ; many words used are peculiar to entomology ; and these the author has endeavoured to explain in the foregoing pages ; other words are purely English, with what is supposed to be a Latin termination added.

966. Examples of this : *setaceous* is Latinized *setaceus* ; *gross* is *grossus* ; *expansion* is *expansio* ; *rudimental* is *rudimentalis* ; *petiolate* is *petiolatus*. Many Latin words are altered to make opposites ; *marginatus* signifies having a margin ; and to describe an object that has no margin, the word *immarginatus* is made ; words, or names, are often Latinized by the simple addition of *us* or *um*.

967. All these are to be considered errors ;

but we must bow in some degree to usage by adopting errors. Still we should be careful to avoid enlarging the list, and in describing, avoid all obvious incongruities, and we should not describe in Latin without some knowledge of that language in its unadulterated state.

968. Reading Latin is a very different matter from writing it, and the author has endeavoured so to explain the technical terms, that the reader may understand almost any Latin description he may meet with, by occasionally consulting a Latin dictionary.

CHAPTER VIII.

OF ENTOMOLOGICAL SOCIETIES.

969. OF a science so generally despised as entomology has been, it is very natural that the few votaries should find pleasure and satisfaction in each other's company; and, conscious of having a worthier pursuit than men give them credit for, should hold sweet council together, and look down on the very world that was looking down on them.

970. Many attempts have therefore been made in this country to establish entomological societies, the history of which it is the duty of the author to record, as far as he is able, from the remaining documents.

971. First. *The Aurelian Society*, which was held at the Swan Tavern in 'Change-alley; the date of its formation is unknown; but from Moses Harris we learn that it existed in the year 1745. The laws and regulations of this society have not descended to us.

972. On the 25th of March, 1748, the great fire which happened in Cornhill burnt down the Swan Tavern, together with the society's valuable collection of insects, books, &c., and all their regalia.

973. The society was sitting at the time ; yet so sudden and rapid was the impetuous course of the fire, that the flames beat against the windows before they could well get out of the room, many of them leaving their hats and canes.

974. Their loss so much disheartened the members, that although they several times met for that purpose, they never could collect a sufficient number to form a society, so that for fourteen years there was no meeting of that sort.

975. Second. *The Aurelian Society* was established in the year 1762 ; it arose, phoenix-like, out of the ashes of the old ; four years afterwards this society was in existence, as appears from the fact, that in 1766, Moses Harris dedicated to it his work entitled the "Aurelian." We have no farther account of it.

976. Third. *The Society of Entomologists of London* was established in the year 1780 ; its minute book is carried down to the first week in August, 1782, at which time it appears to have discontinued its sittings. We hear from Mr. Haworth, that the cabinet of two of its members, Mr. Tinley and Mr. Bentley, were rich in Lepidoptera and Coleoptera.

977. Fourth. *The Aurelian Society* was established in the year 1801; it was proposed and managed by the late Mr. Haworth, the author of "*Lepidoptera Britannica*." The collection was Mr. Haworth's own property, and was to be given up to the society as soon as it should consist of twenty members, which number it never reached.

978. The objects of this society were to form a complete and standard cabinet of the entomological productions of Great Britain; to ascertain their names, uses, and distinctions; the places and times of their appearance, food, economy, and peculiarities; and to point out to the public the readiest and most desirable methods of destroying such as possess properties which are inimical to the welfare of mankind.

979. Any person desirous of becoming a member of this society, was to be approved by every member of the society at the time being; was to give up one specimen of every species in his own collection, which the cabinet of the society did not possess; the elected member was to receive in return duplicate specimens from the society's collection, or money if he preferred it.

980. By these means (say the rules), the Aurelian cabinet must ultimately arrive at the standard of perfection; and the separate collection of every member of the society will gradually increase both in number and value. But, alas, the society, nor the collection, ever attained perfection; the society

was dissolved in April, 1806, and the collection returned to Mr. Haworth.

981. Fifth, *The Entomological Society of London* arose the same year, 1806, as it were, out of the ashes of the first, and consisted of nearly the same members which were in this society. No member was compelled to give up unique specimens to a general collection, but a small collection was formed principally by the generosity of Mr. Haworth.

982. This society made more progress than either of the preceding ; it met regularly, and published three numbers of Transactions, the last of which appeared in 1812 ; but after this, the death of some members and other defalcations brought the society into considerable trouble, and regular meetings were abandoned in the following year, 1813.

983. Sixth, *The Entomological Society of Great Britain*. A third society was formed in 1822, like the preceding, out of the ruins of the old one ; this was a non-subscribing society ; it lasted only two years, and then merged into the Zoological Club of the Linnæan Society of London.

984. Seventh, *The Entomological Club* was formed in 1825 ; this was also a non-subscribing society ; it consisted of eight members, with no power to increase the number ; since its establishment two vacancies only have occurred, each of which has been instantly filled by the election of another member, and the club has continued to

meet every month since the day of its establishment.

985. In the winter of 1831-2, it was agreed, at a meeting of the club, to publish a quarterly magazine, the management of which was undertaken by members then present; the magazine was to be open impartially to all contributors: no preference to be given to the members of the club. The first number of the magazine, called the Entomological Magazine, was published on the 1st of September, 1832, since which period it has appeared every three months with the utmost regularity.

986. The Entomological Magazine is published by Messrs. Westley and Davis, and has attained a very extensive circulation, not confined to this country, but on the continents of Europe and America; it treats not only of scientific entomology, but devotes a large portion of its pages to the history of insects, as connected with agriculture and horticulture.

987. Eighth, *The Entomological Society of London* was formed in 1833; its first scientific meeting was held on the 2d of December of that year; and succeeding meetings have been held on the 1st Monday of every month, from that time to the present.

988. This society has been much more extensive than either of the preceding, having reached, in November, 1834, to the number of

one hundred and twenty-seven members; a remarkable number, considering the unpopular nature of the subject, and the short time of the society's existence. It included among its members most of the publishing entomologists of the present day.

989. Unhappily, however, dissension has arisen on the propriety of expending the funds of the society in publishing Transactions. The advocates for publication being in power, the measure was carried against those of a contrary opinion, greatly to the dissatisfaction of some of the members.

990. On the 1st of November, 1834, a first part of the Transactions was accordingly published. And now another trouble arose: those entrusted with the publication had introduced into the Transactions an uncourteous review of the Entomological Magazine,—a work which, from the first, had zealously supported the society. This has alienated the friends of the Entomological Magazine, and not them only, but many others, who insist that it is an unworthy act of a society to descend to such a course.

Reader ! our companionship ends here. Should the author have persuaded thee, by this unvarnished tale, to follow in his footsteps ; to tread the paths which he has trodden ; to gaze with an inquiring and delighted eye on those things which he has gazed on, it is enough. He bids thee, affectionately, farewell !

THE END.